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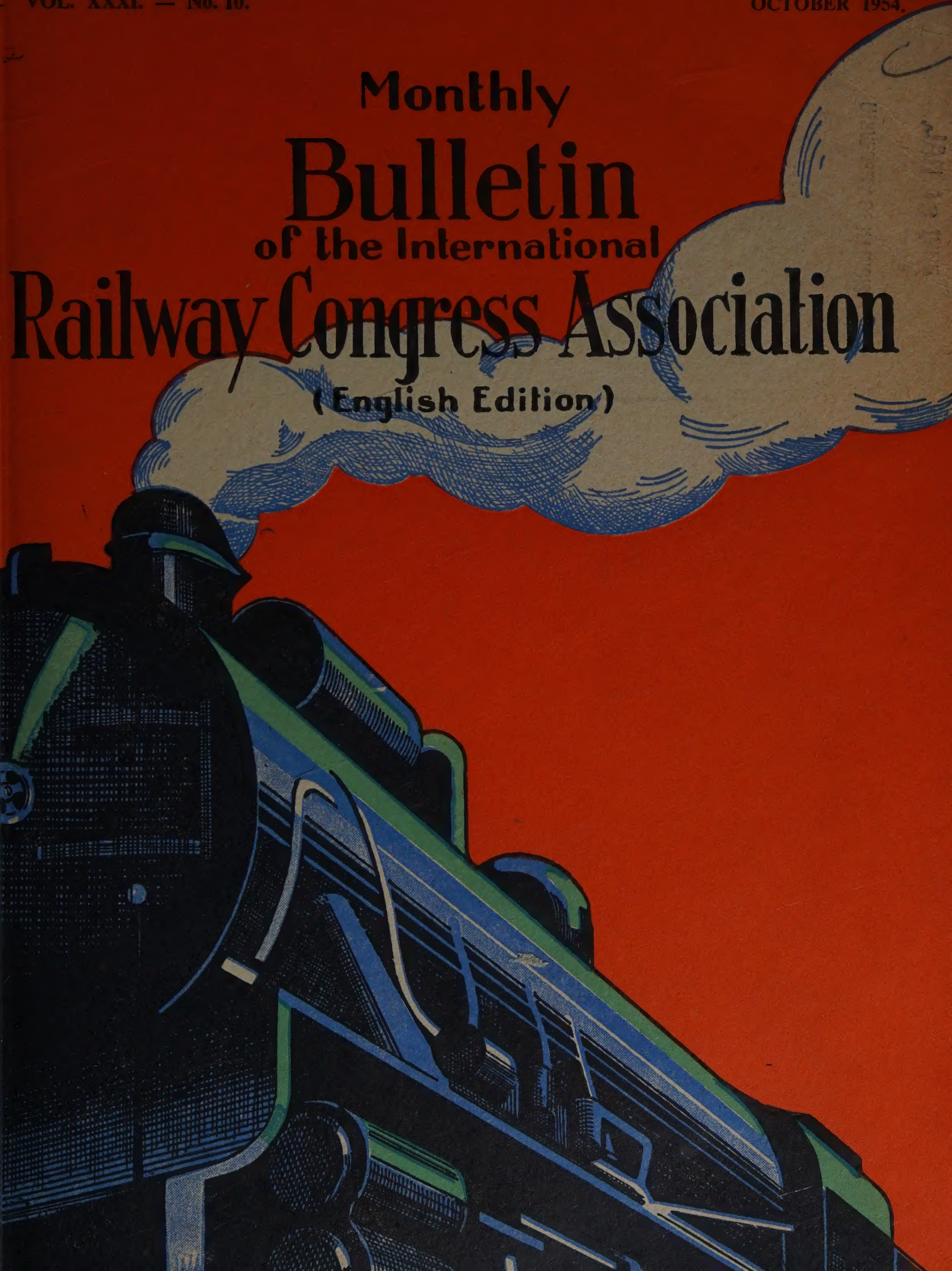
VOL. XXXI. — No. 10.

OCTOBER 1954.

Monthly Bulletin of the International Railway Congress Association

(English Edition)



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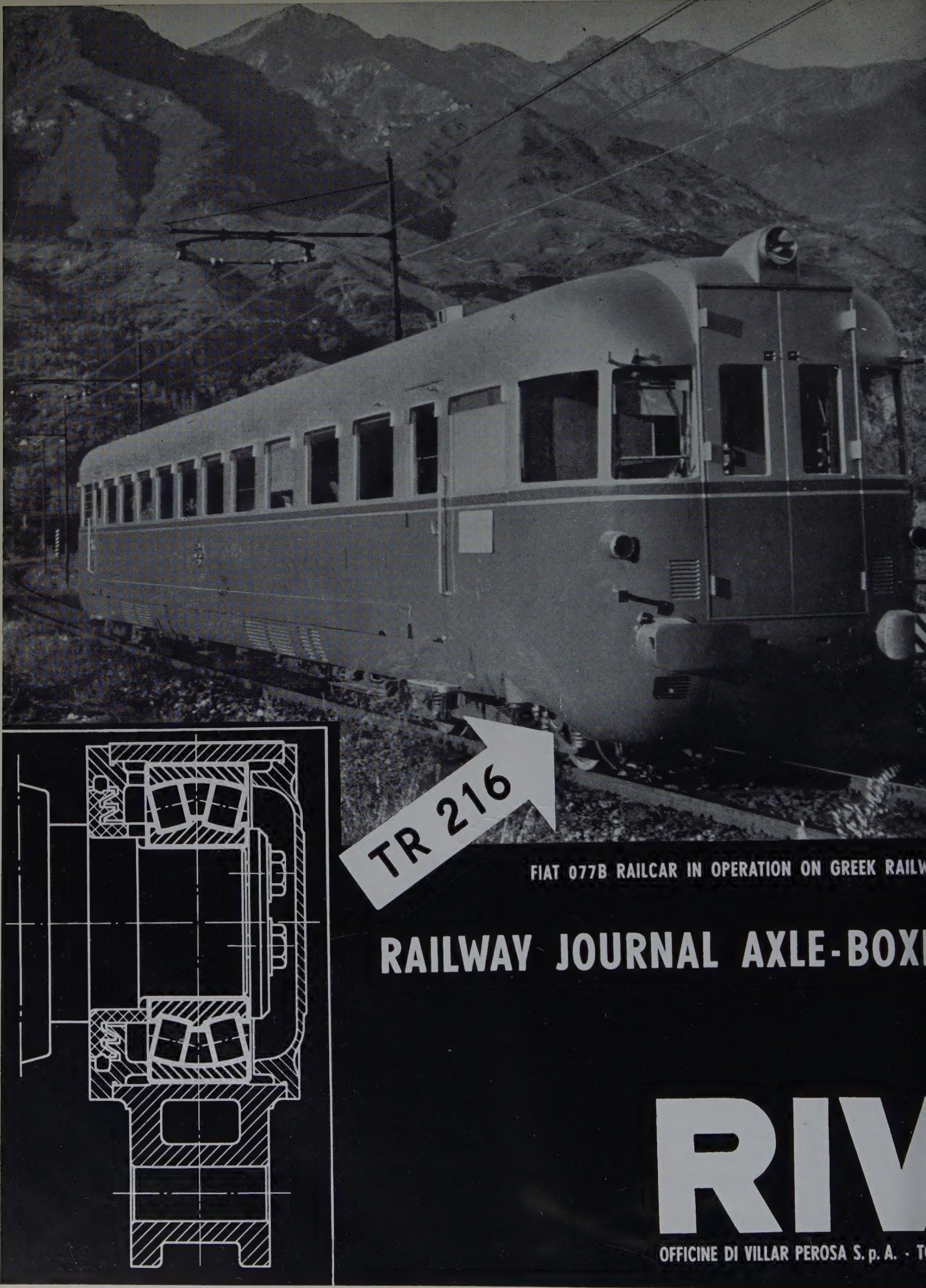

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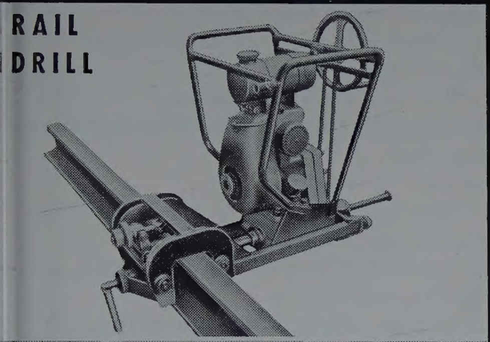

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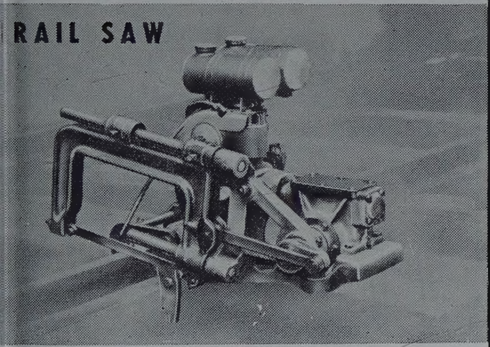

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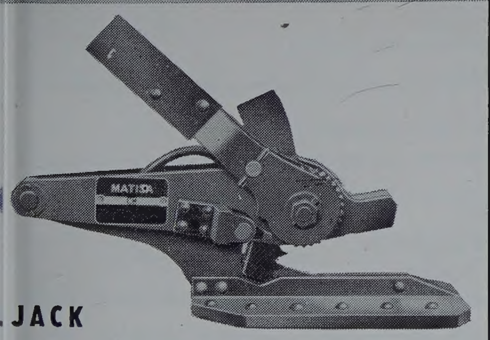

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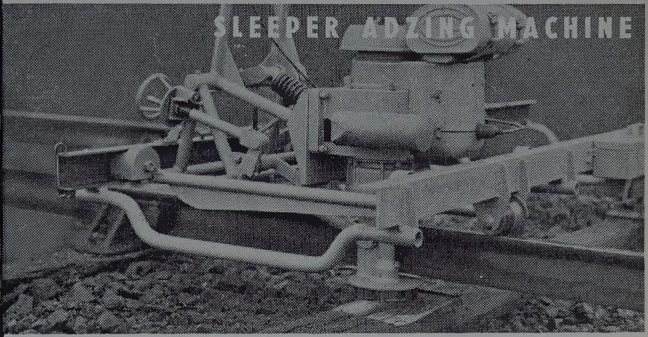

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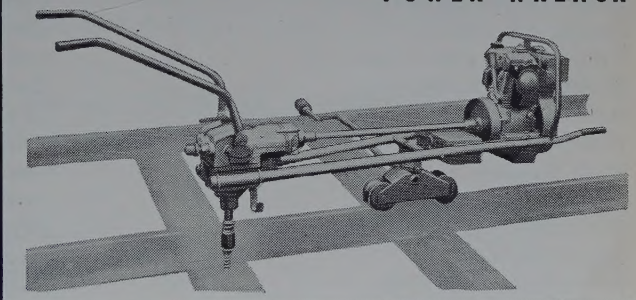

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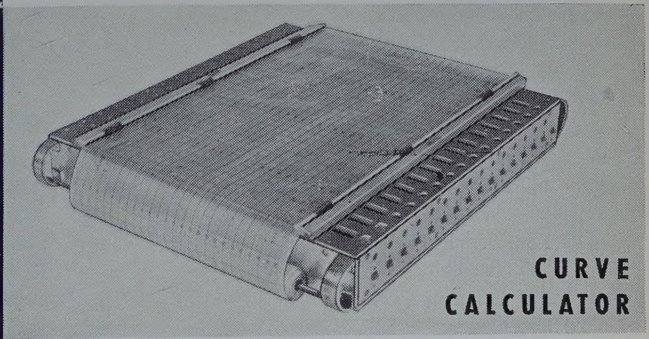

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MONTHLY BULLETIN

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BULLETIN
OF THE
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(ENGLISH EDITION)

[656 .25 (460)]

Modern signalling on the Spanish Railways,

by J. Nogués,
Sous-Directeur du Réseau National des Chemins de fer espagnols.

I. Historical.

Almost all railway systems have in the course of their development found the need to perfect and modernise their signal aspects and methods of working the signals, some of them more than once during the years, with the object of adapting them to the necessities arising from progress in general, from the constant increase in both commercial and maximum train speeds, improvements which had to be effected while, at the same time, raising the level of the coefficient of safety and meeting the growing demand for greater flexibility of working and enhanced traffic carrying capacity.

One factor, which has stimulated this development of signalling of recent times, has been the increasing use of light signals. Their characteristics and the possibilities they offer of solving, in a simple manner, the most complex signalling problems have opened up a new phase in signal engineering and removed certain limitations attaching to earlier practice, going back to the first conceptions worked out in the days of mechanical signalling, the origin of which is as old as the railway itself.

It will be convenient if we note a few relatively recent examples of reforms and improvements in signalling carried out on certain European railways. In France, the S.N.C.F. in 1934 introduced a new code of signal aspects, abandoning the white light for the « line clear » indication and adopting the three fundamental colours, red, yellow and green on main tracks. The Italian State Railways introduced certain improvements in matters of detail between 1940 and 1947. The Swiss Federal Railways modified their signalling regulations in 1946 in order to take account of the various improvements that had been applied in actual practice. Germany altered in 1935 its distant signals by adding a third indication to announce that a diverging route has been set up in advance. Various other improvements have been made also in the matter of colour-light signalling. In Belgium, quite recently, the S.N.C.B. has worked out a new code of aspects for its electrified lines which represents not only an advance on the previous arrangements, but a considerable simplification of them.

On the Spanish Railways, there has been as yet no general and systematic revision of the principles of the existing signalling. The regulations laid down by public authorities were those of the very early days and were very simple, limiting themselves as far as anything definite went to defining how the red disc (outer) signal has to be used and prescribing as fundamental signalling colours white, green and red, with the significations respectively of « clear », « caution » and « stop ».

This very limited nature of the official regulations had as a result that the old private companies — some 20 in all, which worked the lines which in 1941 were formed into what is known as the National System (R.E.N.F.E.) — applied each its own particular ideas, from which sprang the various multiform signalling systems, sometimes even of contradictory character as between the different companies, from certain points of view. We shall proceed to describe, first of all, the main features of the signalling in use prior to the reform which it is the purpose of the present article to explain.

We may mention at the outset that the green light was not used in the signalling of stations and junctions, except by some small lines of purely local importance, which employed it to indicate « line clear ». On the « Norte » and « M.Z.A. » lines, the green light became adopted with the meaning of « next signal in advance is at stop » from 1924 onwards, when the first installations of automatic signalling were brought into use.

The distant, outer, or approach type signal most frequently met with on the Spanish lines is the red disc, with the square or chess-board type signal as an absolute stop signal. Nevertheless, on some lines for similar purposes, semaphores and sometimes colour-light signals are used, but always as two-aspect signals.

The signalling of the small stations on lines of medium traffic, and even on certain main line sections, is almost always limited to a red disc in each direction which serves as what is called a « deferred stop » signal.

There are no fixed signals for indicating a reduction of speed, as called for at station facing points when leading to a diverging route or siding line. The signals are cleared in the same way for either position of the points. It is only at junctions on the open line between stations, of which there are very few in Spain, that the direction to be taken is signalled by means of bracket type signals, or signals carrying arms mounted one above the other on the same post.

At stations provided with starting signals the « on » or « off » position of such signals is not indicated by the home or any other signal. There is no interlocking whatever between starting and home signals. If a train should be required to stop in a station (frequently necessary on single lines), this is effected by keeping the distant (or outer) signal against it (giving rise to risk of mistakes and loss of time).

No interlocking block, or lock-and-block system, is in operation; telephone block alone is employed.

To conclude this short explanation of the state of the signalling at the time the national system was formed, it is appropriate to mention a very interesting element in the situation, and that is the automatic signalling installations laid down in the neighbourhood of Barcelona and Madrid (130 km [80 miles] and 57 km [35 miles] of double track respectively) beginning in 1924 (see fig. 1). These, although they have been working for 29 years have not lost the modern character which they had in 1924, which was not to be found in any of the rare installations of such signalling then in service on European railways.

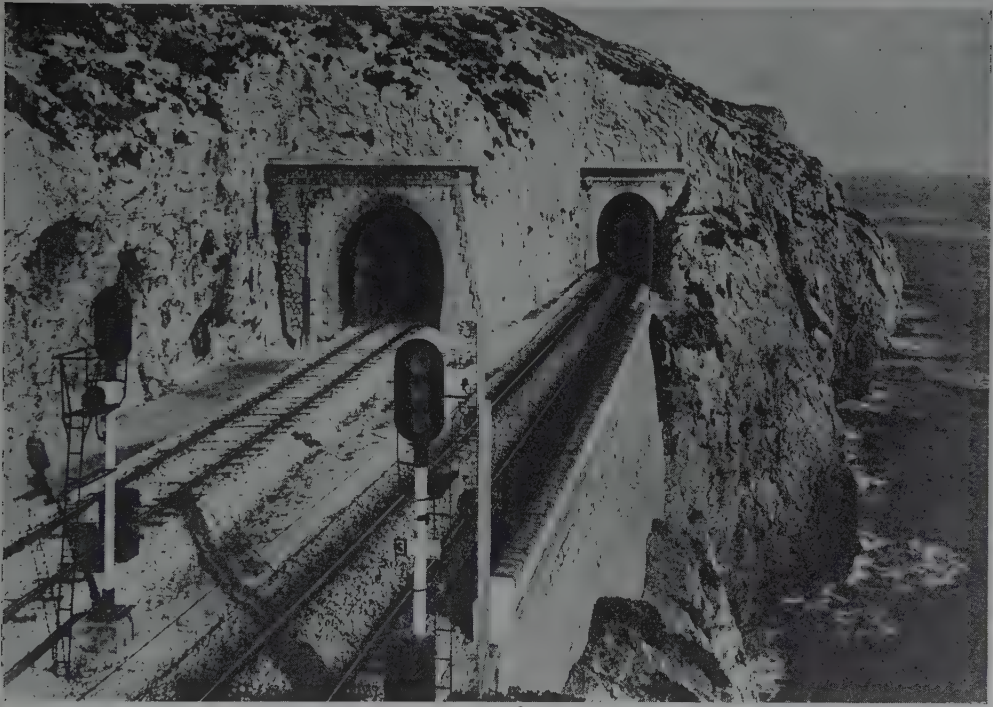

Fig. 1. — Automatic colour-light signalling on the Barcelona-St. Vicente (Saragossa) line.
The signal on the left is located, exceptionnally, to the left of the track to which it refers, to render it more easily visible from the interior of the curved tunnel preceding it.

The colour-light signals are 3-aspect, giving white, green and red lights in comformity with the official rules in force (1). The track circuits are of the A.C. type using 50 cycle current, with double-element relays. The distance between the home and starting signals at a station forms a block section and its signals, which are semi-automatic or « controlled », perform the double function of block and station protection signals. In through running double line stations, the signals are normally at « clear » and work entirely automatically while no points require to be operated to shunt a train. This last operation is protected by approach and route locking, which can be cancelled when a train is present by using a time release mechanism adjustable up to 4 minutes.

This arrangement of the automatic

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(1) See the description of this work in the *Bulletin of the International Railway Congress Association* for April 1930, page 1176.

block installations has allowed of realising considerable staff economies at stations by eliminating signalmen and pointsmen for long intervals and especially at night, when there are no shunting movements at such places.

We consider it useful to make this reference to existing installations that have been in service for a long time on the Spanish Railways seeing the great influence this long experience has exercised on the ideas employed in the reform of the signalling and the new Code of aspects, drawn up to give this reform the uniformity and efficiency indispensable to its purpose.

This experience has led us to pay much greater attention to carrying out the following principles, namely that signalling to-day must not concern itself merely with the safety of train operation but also with economic problems, such as reduction of staff, elimination of time wasting stops and speed reduction, undertaken merely for safety reasons, and the raising of the operating efficiency of the various items of fixed equipment.

II. The new code of signal aspects.

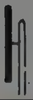
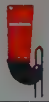
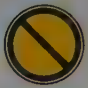
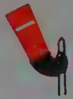
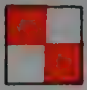
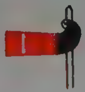
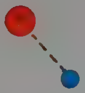
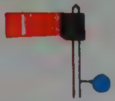
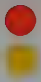
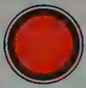
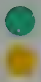
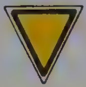
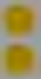
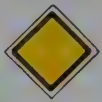
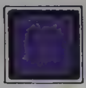
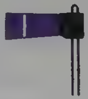
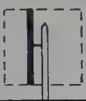
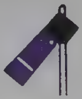
The diversity of the existing types of signal, a consequence of the reasons given above, and the need for completing their significations to give greater flexibility and facilities to the traffic working, especially on single line sections, still very numerous even on the main routes, led the R.E.N.F.E. to adopt a new code of aspects which would both modernise and standardise its signals.

This uniformisation has not, however, been carried out in any too absolute a sense; it had to have the necessary elasticity to enable distinct types of signals, more of less complete and well developed, to be applied on the various lines of the system, in agreement with the importance and character of the traffic met with on them. Consequently, the real sense in which this standardisation has been effected is this : a given order will always be conveyed by the same sign or aspect, whether by a light signal or a mechanical one, and therefore a given aspect will have everywhere throughout the System the same meaning.

In accordance with this conception of standardisation, the new code of aspects, represented in fig. 2., renders identical the night aspects of mechanical signals and their equivalent in colour-light signalling. The lights are always the same as well as the meaning of these light signals, both in the case of their use with automatic signalling and in the ordinary signalling of stations or sections of line unprovided with such a system of block.

This principle, not always followed in other countries, was essential in our case seeing that the use of light signals has not been kept solely to electrified lines or those fitted with automatic signalling, but is also intended to be applied indifferently to steam or electrified lines. Moreover, the present tendency to extend the running of locomotive and train crews, especially in the case of Diesel traction, railcar and « Talgo » type trains, which often run along electrified sections, made it advisable to unify the night indications of all types of signal.

As shown in fig. 2, the new Code distinguishes clearly between signals which govern train movements and those which control shunting operations within station limits.

SIGNAL INDICATIONS		Light signals and night indications signals	Mechanical type signals
RUNNING MOVEMENTS	CLEAR (Proceed at normal authorised speed)		 
	CAUTION (Be prepared to stop at next signal)		 
	STOP		 
	STOP AND PROCEED (Automatic signalling)		
	DEFERRED STOP (Stop before reaching the point protected by the signal)		
	REDUCE SPEED AT NEXT SIGNAL		
	PASS AT REDUCED SPEED		
SHUNT MOVEMENTS	STOP		 
	DRAW AHEAD		 

2. — The new code of signal aspects.

As regards the first, green, yellow and red lights have been adopted for light signals and night aspects of other signals, with the meanings recommended to be given to them by the I.R.U. (U.I.C.) and the Railway Congress. For the second class of signals, white and violet are being used. Similarly, the discs and semaphores used for shunting are of distinctive colours.

The three fundamental indications of

« clear », « caution » (or « approach ») and « stop », those most frequently met with are given each by a *single light.* In this way, the colour-light and night signal aspects offer the maximum degree of simplicity and involve the minimum of expense for installation, working and maintenance. The reasons sometimes put forward for doubling the lights, either the red or the yellow, to eliminate any confusion between these colours at a distance are decidedly debatable, expecially in a country so little subject to fog as Spain, and therefore greater value has been placed on the advantages offered by the use of a single light to convey the fundamental signalling meaning.

The permissive character of the stop indication in automatic signalling, when it may be passed cautiously, the driver being prepared to stop short of any obstruction, will be denoted by a blue light placed diagonally with respect to the red light.

The Code maintains the use, duly standardised, of the mechanical disc and semaphore type signals, with the significations given to them in fig. 2. Such signals will continue to be used as mentioned below on lines with little traffic. The semaphore will of course, give its most efficient service when used as a 3-position signal.

There will be two types of round disc, performing quite different functions; the yellow (one yellow light at night) to indicate that a stop is required at *the next signal ahead,* and the red (with red and yellow lights at night) which will be employed to order a stop to be made before reaching the point protected by the disc and *not itself immediately covered by a stop signal.* The red disc is thus a « deferred » stop signal, which will be used only on secondary lines having the minimum of signalling, restricted to an « outer » signal in each direction at a station. (*Translator's note* : There is no exact equivalent of such a signal in British practice). The red disc will be, exceptionally, the only signal to exhibit a red light that may be passed without previously coming to a stand at the signal.

It has been necessary to create two new aspects in order to give the indications that were missing previously, namely reduced speed, and reminder of reduced speed, the latter indicating the point at which the reduced limit has to be observed. For these aspects, there are the triangular and diamond shaped light aspects (as mechanical signals) and the binary combinations of lights « green-yellow » and « yellow-yellow » for light signals and at night. The binary combinations appear to be the most appropriate to suggest intuitively and mnemonically to the driver the corresponding meanings. Using the combination green-yellow has necessitated the adoption of certain precautions to prevent the accidental extinction of yellow from giving a false « clear » indication. In the case of mechanical signals, the green light will be given by reflection and the yellow directly from the lantern, but in light signalling the two lights will be in series, or a relay used to extinguish the green should the yellow fail.

The code just set forth is made up of a very small number of simple indications. Nevertheless, it is considered that they suffice for the present needs of the railway system, even on the busiest sections while these aspects will allow of considerable progress being effected in the present signalling of ordinary through running stations.

There is no doubt that this Code is capable of being carried further in the future, without affecting its essentially uniform nature, when it shall prove necessary, on lines equipped with automatic or light signalling, to cope with traffic peaks involving a succession of trains running at very close intervals and thus make better use of the great powers of acceleration offered by the new methods of traction invested with high specific power output. By changing certain lights into flashing lights, we shall be able to obtain a greater degree of distinction between the various indications, especially as regards those concerning reduction of speed and resumption of normal speed.

III. Types of station signalling.

It was necessary that the nature and extent of the signalling on the different lines of the System should bear relation to the volume and characteristics of their respective amounts of traffic. With this in view, the various lines have been classified as follows :

a) main lines, formed of double and single track sections, carrying heavy fast traffic and a high proportion of through trains, both passenger and freight;

b) lines of medium traffic with few through trains;

c) lines of small traffic and no through trains.

Evidently it is on lines of group *a*) that signalling is called on to give its greatest benefits as regards flexibility and economy of working. This is why, on these lines, it has been decided to apply a complete and uniform system for through stations which, in general, will be composed of :

- a distant signal having two lights (green and yellow) giving three indications, namely « clear », and « caution » (warning of approach to a stop indication) and « warning of approach to a reduced speed indication »;
- a home signal with three lights and three indications, namely « clear », « stop » and « caution ». It may at times also give a fourth indication of « reduced speed at next signal ».
- a starting signal with two lights and two indications « clear » and « stop ».

This signalling of the group *a*) lines could have been effected by using 3-aspect mechanical type signals or even at need by using groups of 2-aspect signals; but this last solution would in 1953 have represented a retrograde step technically, not compensated for by turning to account equipment coming from installations having reached no great degree of development and which would, generally speaking, be out of date.

It was thus necessary to put in new signalling; whether colour-light or mechanical type signals should be used was not open to doubt, despite the higher installation cost of the former. Light signals are now admitted to be superior, as regards visibility in all weathers, their smaller volume and their adaptability to the most complex operating conditions, the rapidity with which they can be worked, and readiness with which their functioning can be proved or detected. There was, however, another argument in favour of light signals. The R.E.N.F.E. was faced with having to make a change in its Code of aspects under full working conditions, and one which entailed a

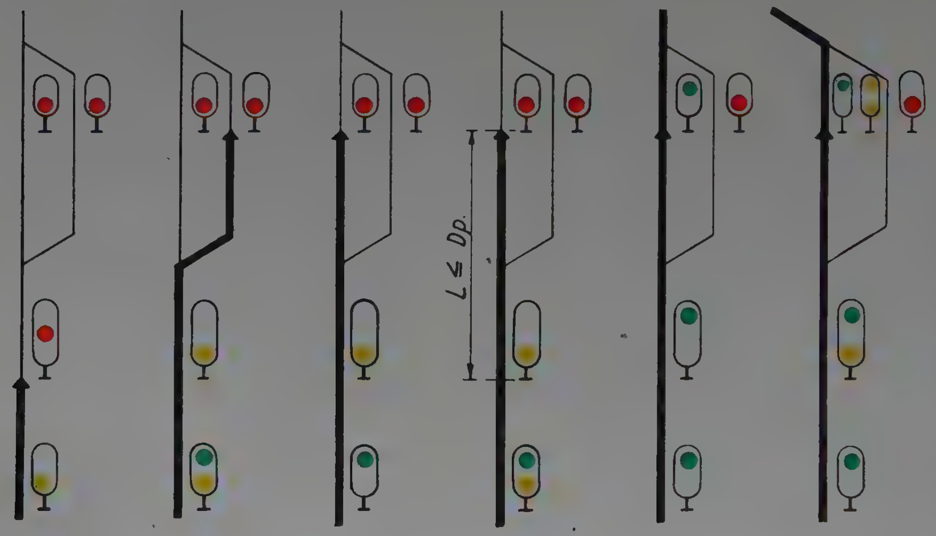


FIG. 3

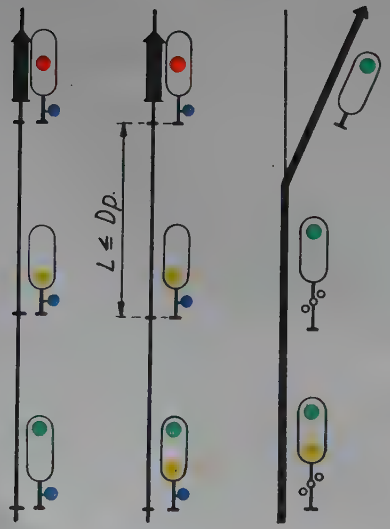


FIG. 4

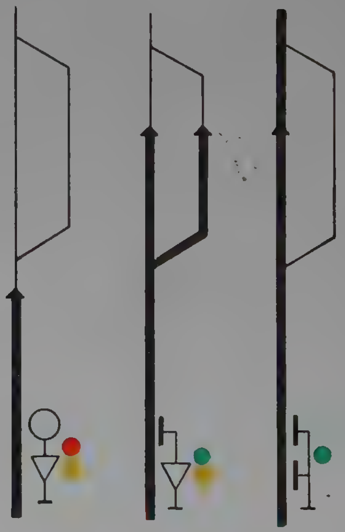


FIG. 5

Fig. 3. — Colour-light signalling at a station with facing loop connection.
Dp = full braking distance.

Fig. 4. — Automatic signalling indications between stations using colour light signals.

Fig. 5. — Application of 3-aspect red disc (outer) signal.

substantial modification in the appearance and meaning of the colours used in it. Once installed over a given section of line and working in accordance with the old Code of aspects, light signals without doubt offer the greatest facility for being changed at a given moment to conform to a new Code and with the desired rapidity, the object being to eliminate the temporary co-existence of two distinct Codes on lines worked over by the same train crews.

It is to be noted, in addition, that the stations would then be in a condition to have automatic signalling applied between them, should that become necessary in future, for which it would suffice merely to put in the required intermediate signals along the line and modify the indications of the distant and starting signals at the stations to agree.

Fig. 3 gives the working of the signals just described for the various movements taking place in a station, either on single or double track, with points taken facing.

This signalling is in reality a two-speed signal system reduced to its maximum degree of simplicity. It was decided not to use multiple directing signals, still seen in various countries. Their installation and working are much more troublesome, while placing them in cuttings, tunnels, or on electrified lines frequently presents serious difficulties from the point of view of visibility.

In general, the signal intended to indicate the point where reduction of speed must be observed is not made use of, it being considered unnecessary except where a « clear » signal has to be shown at the place in question.

Fig. 4 illustrates a few examples of automatic signalling between stations and at a running junction. At such junctions, above all on electrified lines, it is proposed to employ, in place of the cumbersome multiple direction signals, the same system of speed signalling as at the stations, completed in this special case by a simple geographical direction indication given by an arrow or three white lights arranged as a position signal. This will be shown both at the distant signal and the signal immediately in rear of the facing points.

On sections of route equipped in accordance with group *b*), all single lines, the simplified mechanical signalling is installed. Generally speaking, it is limited to two outer signals, giving three indications (fig. 5).

To enable the operating staff on such lines to be reduced to the minimum necessary for effecting easily the crossing of trains, the points giving access to the loops have been made trailable. To give the clear signal for a train to run through at normal speed on the direct route (fig. 5) the facing points require to be bolted and interlocked with the operating lever of the signal. On the lines included in group *b)* subject to unfavourable local or climatic conditions (strong winds, fogs, etc.) the uncertain and poor light obtained from oil lamps is replaced by electric lamps (see fig. 6), which, in fact, constitute a light signal; but since they only need to function as night indications, small lamps of minimum power suffice (1 watt), which makes it possible to use economically large capacity batteries to feed them where no outside power supply is available.

On lines of little traffic, group *c*), to obtain a simple and economic method of operation, the workable outer signals are dispensed with and replaced by simple fixed warning approach boards without their own means of lighting, giving notice to drivers that they are nearing a station.

Fig. 7 is a map of the Spanish National Railway system, showing the types of signalling to be met with when the plan for reforming it, now in course of execution, shall be completed.

This plan is being carried out in stages, priority being given to signalling the entrances to stations, with the object of realising as quickly as possible the change in the Code of aspects; 550 stations and about 4000 km (2 485 miles) of lines will be equipped with the new colour light signalling, or one-third of the whole system, although, in reality, such signalling on the principal routes will deal with 70 % of the total traffic carried.

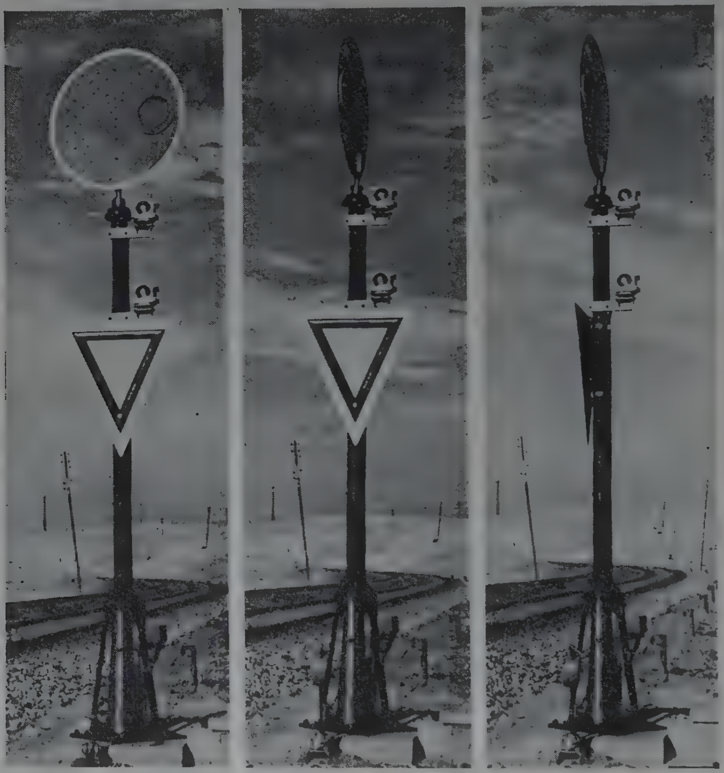


Fig. 6. — Distant disc signal giving 3-aspects.

Left : caution, one yellow light.

Centre : reduced speed at next signal; green and yellow lights.

Right : clear, proceed; one green light.

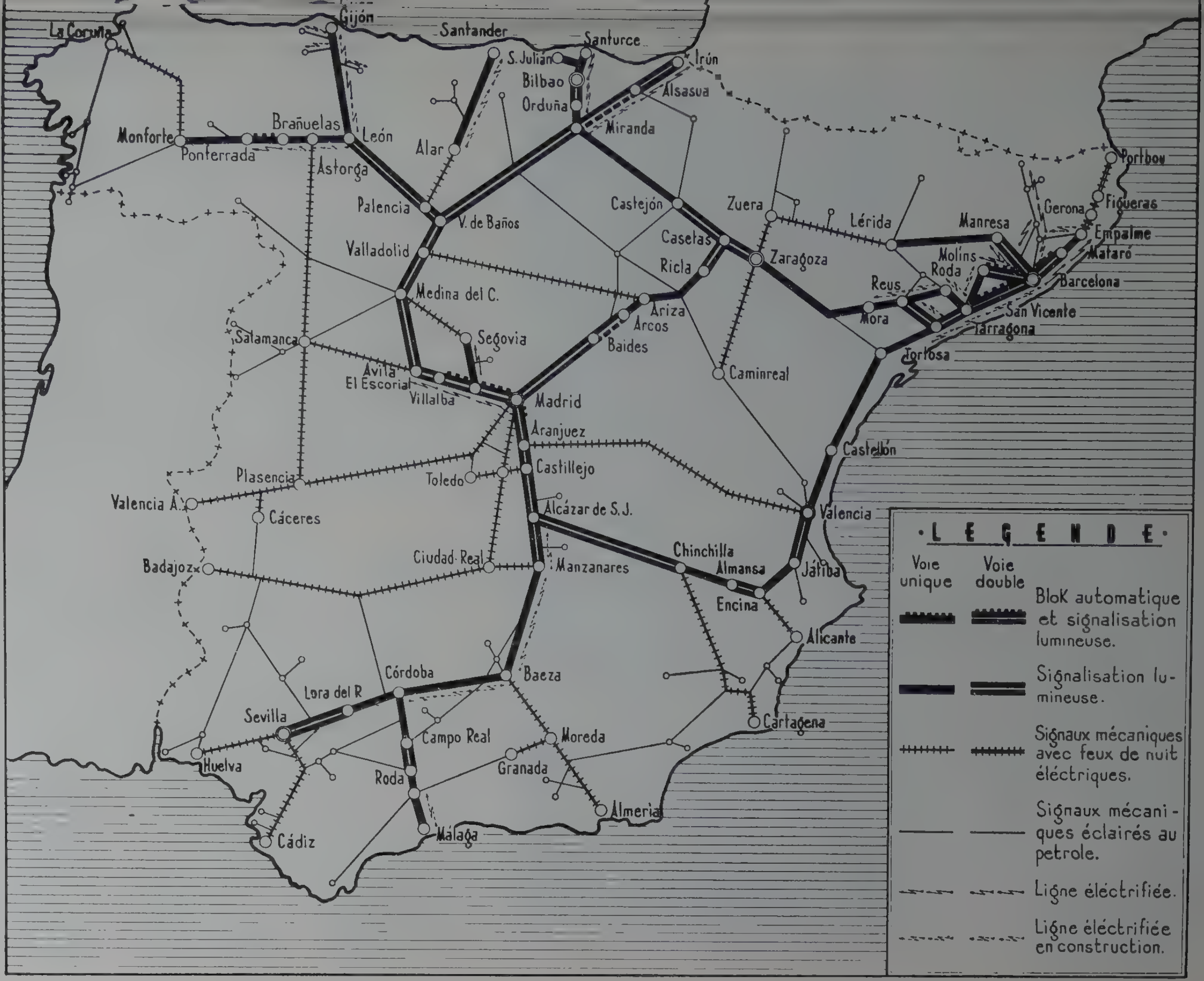


Fig. 7. — Map showing the new signalling being applied to the RENFE lines.

Explanation of French terms :

Voie unique = single line. — Voie double = double line. — Block automatique et signalisation lumineuse = automatic colour-light signalling. — Signalisation lumineuse = colour-light signalling. — Signaux mécaniques avec feux de nuit électriques = mechanical type signals, electrically lighted. — Signaux mécaniques éclairés au pétrole = mechanical type signals, lighted by oil lamps. — Ligne électrifiée = electrified line. — Ligne électrifiée en construction = electrified line under construction.

IV. General principles and methods.

The operation of the new light signals, which replace the old mechanical ones, has to be effected with the aid of the mechanical interlocking arrangements and mechanisms already in service, it being desired to retain these as far as possible.

These arrangements — we are referring still to those at the smaller stations, by far the most numerous — are of the most varied designs; very often they are mechanical signal boxes, mostly with double-wire transmissions. There are a few electric ones of the « all-relay » type of recent date. At other stations, such interlocking as is absolutely necessary is effected by means of « Bouré » type key locks, in various arrangements (with or without a central key lock and with or without mechanical transmission of keys). In the face of this diversity of types of equipment and methods, mixed electro-mechanical arrangements have been adopted, except in those cases where « all relay working » had been put in, it being endeavoured to get the greatest possible degree of similarity between the various installations, especially in those details and parts of which the staff have to make use when operating the equipment.

With this object, the control handles and proving and detecting indications have been grouped together in geographical form on a small wall diagram panel (see figs. 8 and 9). These panels are installed in the office of the official who conducts the working of the station (often the stationmaster himself), who actuates them personally. Such direct manipulation affords greater safety and rapidity of operation and often allows of realising a saving in signal and point operating staff, especially on double lines where there are long sections of route where no train is required to take siding at a station.

To effect this at stations where there are mechanical signal frames — which are customarily installed in separate signal boxes apart from the station building itself — the operation of each light signal is effected by means of a circuit which puts in series the controlling arrangements on the stationmaster's panel and those in the signal box. In order to clear a signal both these controls must be brought into the « signal off » position. On the stationmaster's panel, the operating switch is a small rotary handle or knob; in the signal box, it is a combined electric lock and circuit controller, actuated by the same lever that worked the mechanical signal, now replaced by a light signal.

This lock makes the release of the route set up dependent on proof that the signal itself is properly at danger and that there is no train in the approach section or passing over any of the points.

In agreement with what has been stated above, the signal can be operated exclusively by the stationmaster, without anyone having to be in the signal box; to allow of that it suffices to leave the through running routes set up in the signal box and the levers in the appropriate positions.

Fig. 9 illustrates a panel for a station interlocked by « Bouré » key locks. In this case, the interlocking between the light signals and points is obtained in the following manner: the station has a central « Bouré » key lock apparatus, from which a key can be extracted for each definite route (direct run through, arrival of train on loop line, etc.). These keys are inserted and turned in locks to correspond on the stationmaster's panel and operate the signals by means of contacts. In certain cases, these locks are fitted with an electric lock for the purpose already mentioned above.

The lamp indications on the panel have been standardised and simplified by limiting them to those most useful for carrying on the working quickly, as with the system adopted no such indication performs any actual safety function. The following indications have been regarded as sufficient for all purposes, namely : « signal off », « track circuit occupied », « point locked electrically » and, in the case of electrical installations « discordance between points and controlling handle or knob ».

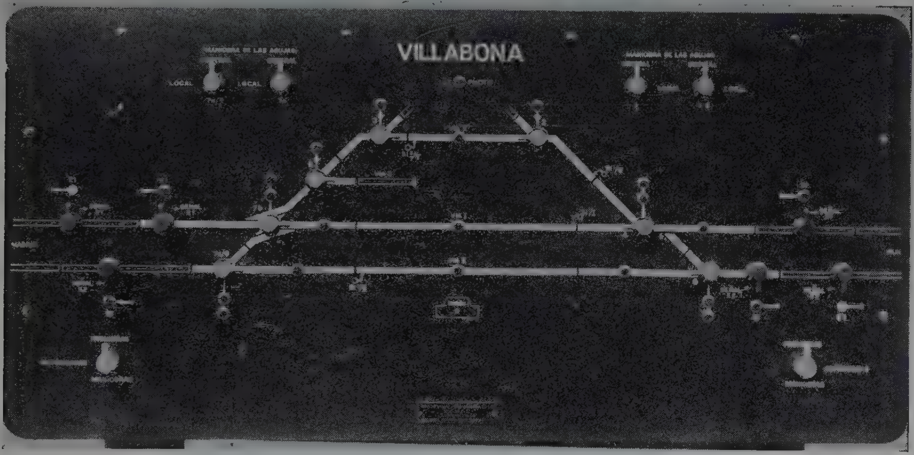


Fig. 8. — Control panel for working signals and points « all relay » system.

The safety installations in these through stations on the main lines have, in addition, as a general and uniform practice and whatever the interlocking system used may be, the following arrangements :

a) automatic replacement to danger of both home and starting signals when a train passes them, with what is called « stick control », which obliges the stationmaster to confirm this action by replacing his control handle or knob to normal;

b) constant and positive detection of the tongues of the facing points on the main line;

c) approach track circuits used for the interlocking and lighting up of the home signals on the approach of a train for the purpose of prolonging the life of the signal lamps and saving current at stations having a battery supply where an outside power supply is not available. It has been decided not to do this however on electrified lines between the distant and home signals on account of the high cost of the impedance bonds then required;

d) track circuiting on the main line between home and starting signals, conveniently divided up to meet requirements and, in special cases, also on the loops, to prevent the clearing of a signal if the route concerned is not clear of vehicles and to carry out the interlocking of route.

A detail worth mentioning is the simplification effected in the starting signals at the small stations. Generally speaking, instead of having a starting signal for

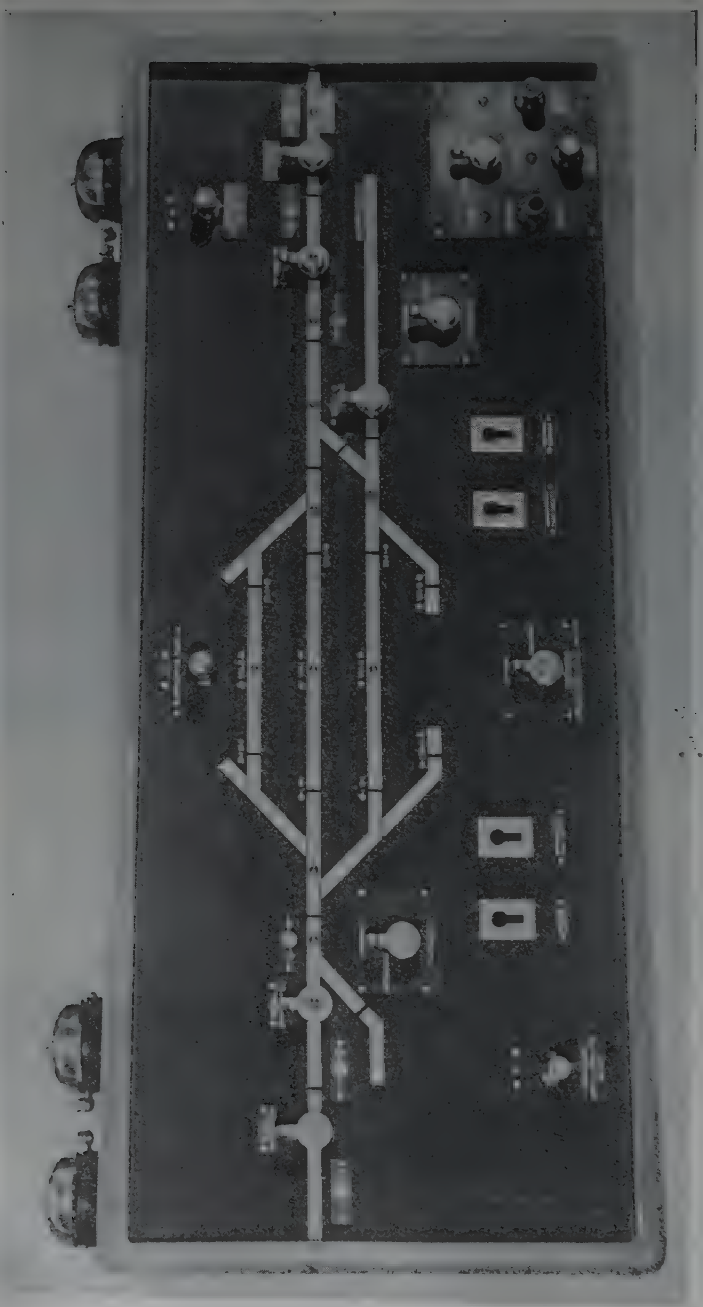


Fig. 9. — Control panel for working signals at station interlocked by « Bouré » keys.

each outgoing track, only one such is provided (fig. 10) placed beyond the converging points. This eliminates multiplication of the controlling and detecting arrangements and simplifies the interlocking between the signals and the interlocking block (lock-and-block) apparatus. Nevertheless, as a result of this simplification, in certain cases this arrangement is completed by installing individual dwarf type signals to show the places where trains must stand and to indicate plainly for which one, when several happen to be in a station, the starting signal itself has been cleared. These dwarf signals are simple repeaters of the starting signal and are operated in conjunction with it through a selecting circuit over contacts on the point detectors; there are no means of controlling them on the stationmaster's panel.

As regards the interlocking block between stations, to which reference has just been made, the management is still in course of choosing the most suitable solution. We are not burdened on the Spanish Railways, as is the case in other countries, with an inheritance of a great number of installations of various systems of manual block apparatus now technically out of date. We therefore enjoy considerable freedom of choice as between the various modern solutions of the problem, in which the train itself automatically controls the giving of « line clear ». We have several on trial at the moment, with a view to adopting that which proves best adapted to the characteristics of our railway system. For these reasons, we are trying single-line block apparatus, either with the line normally blocked, or closed, until permission is asked to send a train, or with the arrangement by which a stationmaster can, without asking such permission, take possession of an unoccupied section for a train he wishes to send forward; these arrangements work either with coded currents sent over the line wires, or currents of different frequency for each particular function.

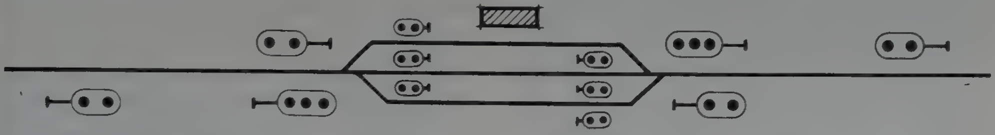


Fig. 10. — General arrangement of colour-light signals at a single-line station.

This description will have given, we hope, despite its brevity as a technical article, an idea of the steps being taken to resolve the complex problem of standardising and modernising the signals on the Spanish National Railways. In solving that problem, the endeavour has been to maintain a fair and reasonable middle course and renounce certain solutions, perhaps actually more attractive and more perfect, but which would have led us to incur excessive expenditure. Nevertheless, we have not failed to apply when judged indispensable all the resources which the present position of signal engineering offers us for obtaining greater safety, additional flexibility and speed of traffic working, and a better organisation of the work to be done in the stations, which will itself result in savings in operating costs.

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Passenger traffic peaks on the S.N.C.F.

The loads involved and the methods to be employed to meet them,

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à la Direction du Mouvement de la Société Nationale des Chemins de fer français.

I. INTRODUCTION

The creation of a regular and economic passenger service, permanently giving the public fast services at the most convenient hours, and completed by good connections at the junction stations and terminus stations, is in itself a difficult problem to solve; but this problem is rendered much more complex by seasonal or exceptional movements of the populace, leading to a sudden increase in traffic; this traffic may even become a « peak » traffic on certain days more particularly favoured for travelling.

Such movements are due to :

a) school holidays;

b) the departure of families living in the large towns to holiday, health or bathing resorts;

c) travelling in connection with sports, camping and spas;

d) journeys facilitated by the social laws (paid holidays, holiday camps, etc.);

e) tourist traffic from abroad which often coincides with the days on which a large number of the native population is travelling.

The railway is the only method of transport technically capable of meeting these sudden peaks. Consequently, this practical monopoly (perhaps the only one remaining to it) gives it a social role of the first order, since it is able to meet the legitimate aspirations of the most modest passengers.

The railway must therefore take the necessary steps in every field to assure this task; it will often be judged on the way that it has handled such « peak » traffic.

In addition, it must not be forgotten that large scale passenger movements, nearly all travelling at lower rates than the normal fares, must be assured economically, so that the whole service will not show a deficit as a result thereof.

The object of the present article is to report, in the case of the S.N.C.F.:

1°) the problem of « peak traffics » which it has had to solve;

2°) the technical and rating measures it uses to meet them.

II. THE IMPORTANCE OF PEAK TRAFFIC

Normal traffic, which broadly speaking runs from the month of October to the end of the following June, can be taken as stable, in spite of certain spurts in the passenger traffic around Christmas, the

New Year and Easter; this represents the basic services. But these services must be considerably increased to deal with the seasonal summer traffic and peak periods of traffic which occur during this period.

1°) Summer seasonal traffic.

Graph I below, relating to the year 1952 for the S.N.C.F., gives the evolution of the mileage of the passenger trains and passenger-km month by month (suburbs of Paris excepted).

This shows that :

— between the months of February and July, the period of heaviest traffic, the passenger traffic (number of passenger-km) increases from 1 to 2.50, i.e. is more than doubled;

— during the three summer months the average traffic is nearly 75 % higher than the average traffic for the other months of the year. The curve remains the same from year to year, with slight differences owing to the moveable holidays.

This seasonal variation is general troughout Europe; the ratio between the month with the heaviest traffic and that with the lowest traffic (usually July or August and February) in 1952 was respectively :

in France	226 %
in Spain	189 %
in Italy	175 %
in Norway	167 %
in Holland	141 %
in Germany	133 %
in Switzerland	121 %
in Belgium	119 %

This table shows that in France, the difference is appreciably higher than in the other neighbouring countries. This is due partly to the existence of a very large capital city with large suburbs where about 1/6th of the French population is concentrated, and on the other hand to the fact that France plays an important role in international tourist traffic.

2°) Summer peak traffic.

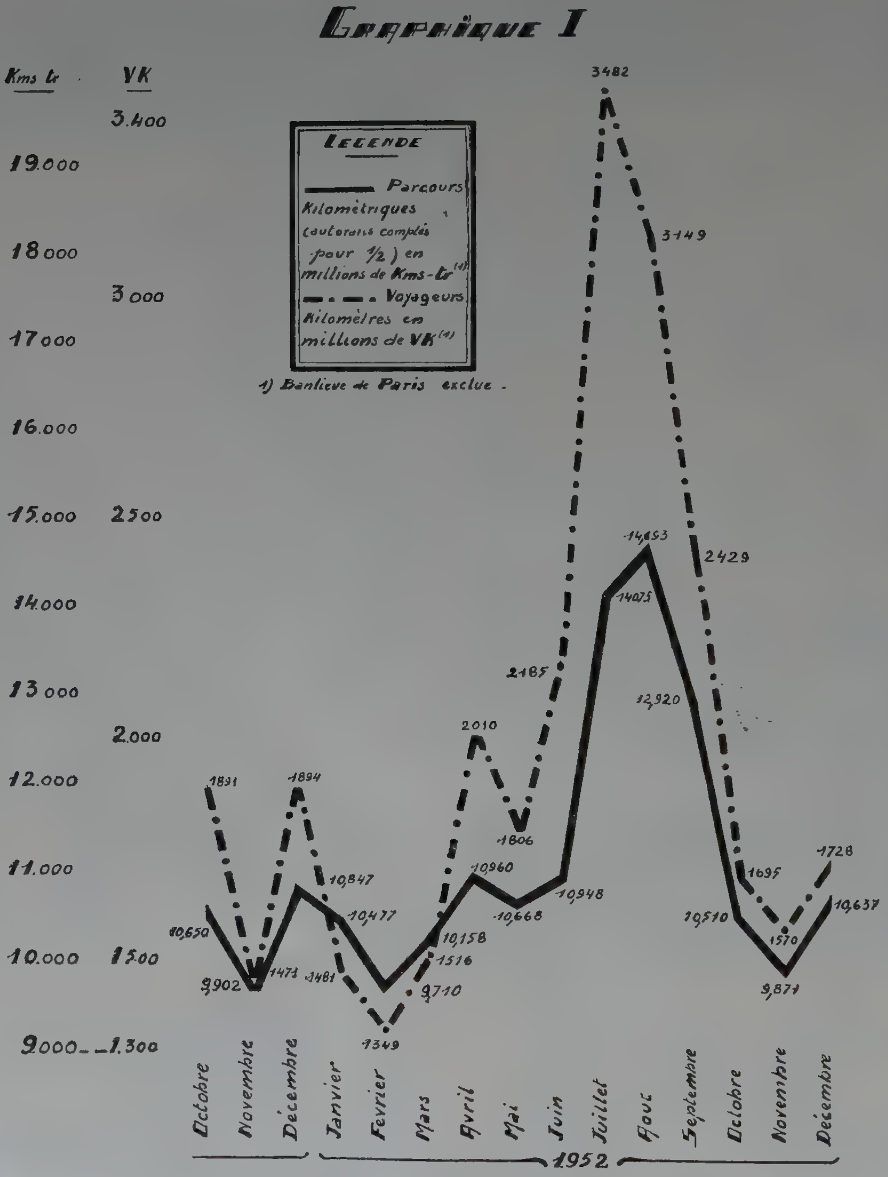
Graph II, relating to the years 1951 and 1952, shows the evolution of the passenger traffic in the Parisian stations during the periods when people are leaving for their holidays (from the 26th July to the 8th August 1951 and 24th July to 6th August 1952); during this period, the already very considerably increased traffic is swollen by 50 to 80 %; in particular from the 1st to the 4th August 1952, the average number of main line passengers leaving Paris was about 180 000 with 79 000 reserved seats and 250 special fast and express trains, which corresponds to an average of 720 passengers per train.

To this passenger traffic must be added a very large amount of luggage to be transported necessitating several special trains.

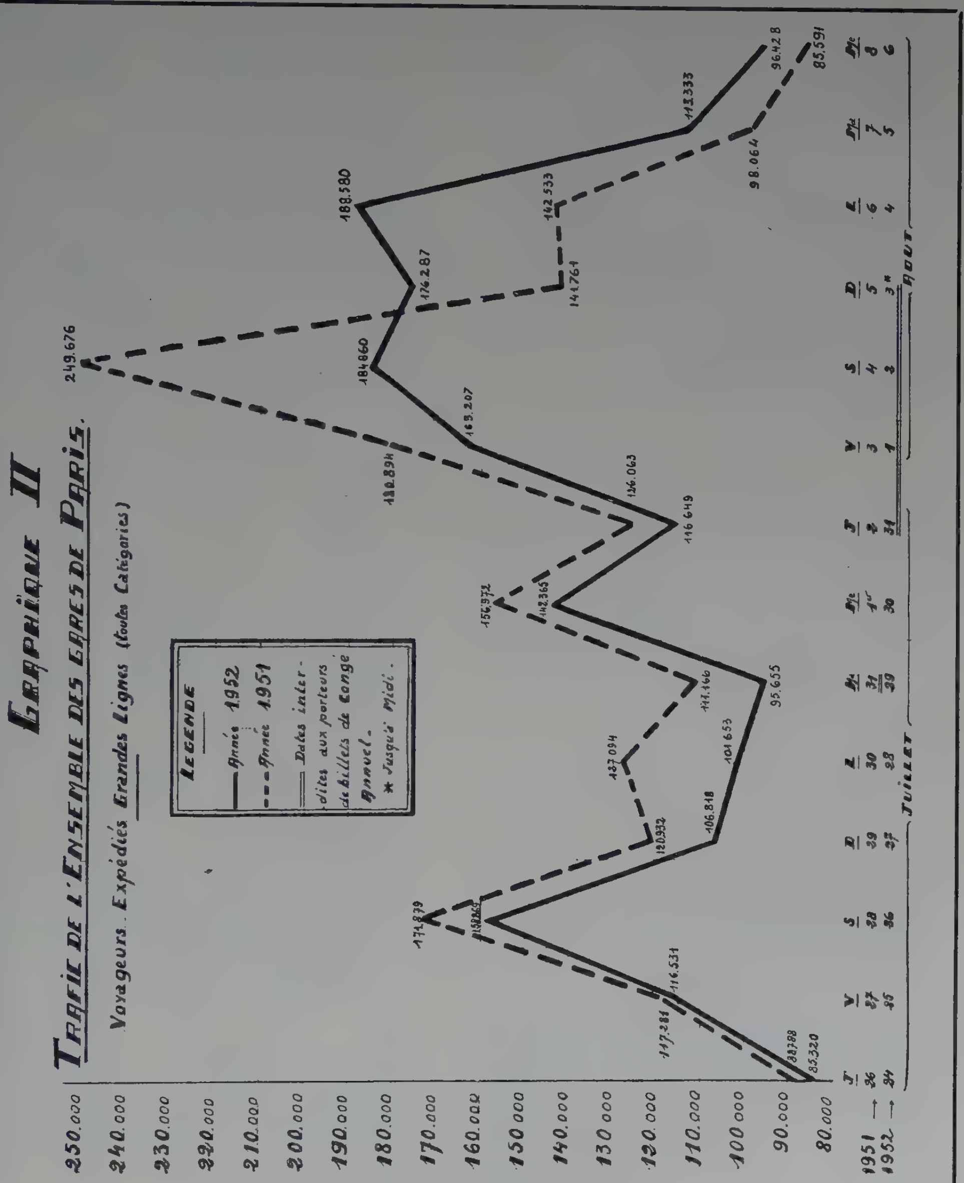
How is such a traffic to be worked economically with the means at our disposal? This is the problem that has to be solved.

III. TECHNICAL AND RATING MEASURES TAKEN

The ideal obviously would be to have the mileage of the trains varying to the same extent as the passenger-miles, but it is obviously impossible to run a passenger train service in such conditions; it would lead to times that could not be



Graph. I. — Legend : —— Mileage (railcars counted as ½) in millions of tr/km (1)
—·—· Passenger km in millions of passenger/km (1).
(1) Excluding the suburbs of Paris.



Graph. II. — Traffic at the Paris stations as a whole.
Main Line passengers leaving Paris (all categories).
Legend : —— Year 1952.
– – – Year 1951.
═══ Dates at which holders of annual holiday tickets are not allowed to travel.
* up to mid-day.

fitted in with the working and become in the end a nuisance to the passengers themselves.

The passenger services are therefore based on a series of trains which over the year as a whole correspond to normal requirements; these services, known as the « basic services » are in force from October to the end of June in the following year; they merely have to be reinforced during the winter sports period by running a few extra trains temporarily, especially to the Savoye.

1°) Temporary summer programme.

This basic service would however be absolutely insufficient during the three summer months (July to October). The basic trains can then be reinforced by a certain number of « temporary trains » which run according to the traffic they have to deal with; the times of these trains are carefully linked together, care being taken to make them connect in the stations at which the routes cross, so as to introduce in this way a new « temporary network of services » at different times to the regular services carrying their own traffic.

This organisation of the train services has many advantages :

a) from the technical point of view the trains are planned in advance and the dates they will be introduced decided; in this way, they are known to the public together with their connections; they make it possible to avoid systematic doubling of the regular fast and express trains, which assists regular running;

b) from the point of view of the convenience to the public, the latter are able to organise their journeys in advance as these trains are given in the Timetables from the beginning, so that there is a better distribution of the passengers between the different trains;

c) from the point of view of economy, this method makes it possible to regulate in advance the movements of the staff, engines and rolling stock and reduce light running; in this way, the available resources are used to the best advantage.

On the S.N.C.F., the daily mileage of the temporary summer trains were as follows during the last 5 years :

1948 : 68 000 km (42 250 miles) compared with 347 000 km (215 610 miles) for the regular trains;

1949 : 88 000 km (54 680 miles) compared with 344 000 km (213 750 miles) for the regular trains;

1950 : 90 000 km (55 920 miles) compared with 342 000 km (212 510 miles) for the regular trains;

1951 : 80 000 km (49 710 miles) compared with 353 000 km (219 340 miles) for the regular trains;

1952 : 79 000 km (49 090 miles) compared with 356 000 km (221 200 miles) for the regular trains.

This shows that the temporary summer trains represent about 25 % of the regular trains, whereas during the period they are run the traffic increased by about 75 %; as Graph III shows, the average user of passenger trains, which in normal times oscillates between 140 and 180 passengers per train (for the sake of comparison, this figure was 84 in 1938), is rather above 200 in July (231 in July 1950, 258 in July 1951 and 247 in July 1952).

2°) Supplementary peak traffic programme.

The introduction of these temporary trains does not solve the problem caused by « summer peaks », the most important of which has so far been that of the « end of July — beginning of August ».

The S.N.C.F. then puts into force a heavy programme of doubling and increasing the length of trains, especially those starting from the large stations of Paris (Montparnasse, Austerlitz and Paris-Lyons are the most heavily loaded). This programme is drawn up in advance, in the form of a graph, based on the results obtained the previous summer and on information on the traffic collected from the inquiry offices, booking offices, travel agencies and important groups of passengers; they include a reserve for unexpected traffic.

This programme is advised in advance to all those concerned (Stations, Traction, Rolling Stock, Maintenance, Control Posts, Information Offices, Town Halls, Travel Agencies, etc.) so that all of them, in their own sphere, can organise their work without waste of the available resources; the special movements of the engines and staff, the constitution of the rakes and increased trains, graphs showing the occupation of the lines in the large stations, graphs showing the way the rolling stock is to be made available, and graphs showing the making up of the trains in the corresponding yards, are all prepared in this way.

The number of additional trains for the peak traffic is a very important item; as Graph IV relating to the period from the 27th July to the 4th August 1952 inclusive shows, the number of fast and express trains run *daily* from Paris was on the average 217 including 43 additional trains, with a peak of 263 trains on the 2nd August, 89 of which were additional trains. These additional trains involved the use of about 1100 coaches, in view of the turn round of the rolling stock (usually 2 *days* [2 jeux]).

The S.N.C.F. rolling stock has considerably diminished in quantity if not in quality since 1939.

At that time, they had (excluding the suburban rolling stock — 1 300 metal coaches — because of its specialist nature):

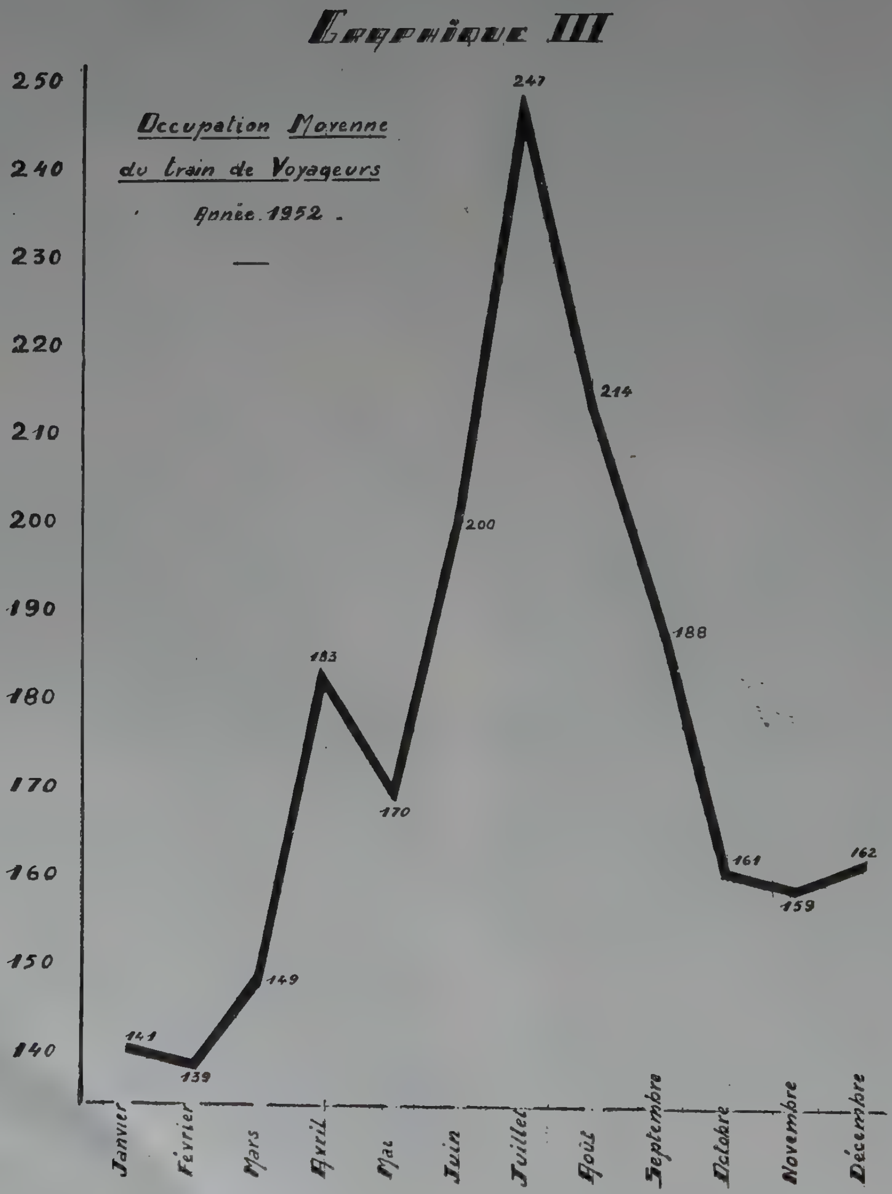
4 100 metal bogie coaches,
5 000 bogie coaches with wooden bodies,
19 300 non-bogie coaches,
i.e. a total of 28 400 coaches in all.

Owing to the war, loss of rolling stock during the occupation, and because of bombing, the reduction due to altering very old coaches, in spite of new constructions, the stock of coaches on the 1st August 1953 was as follows :

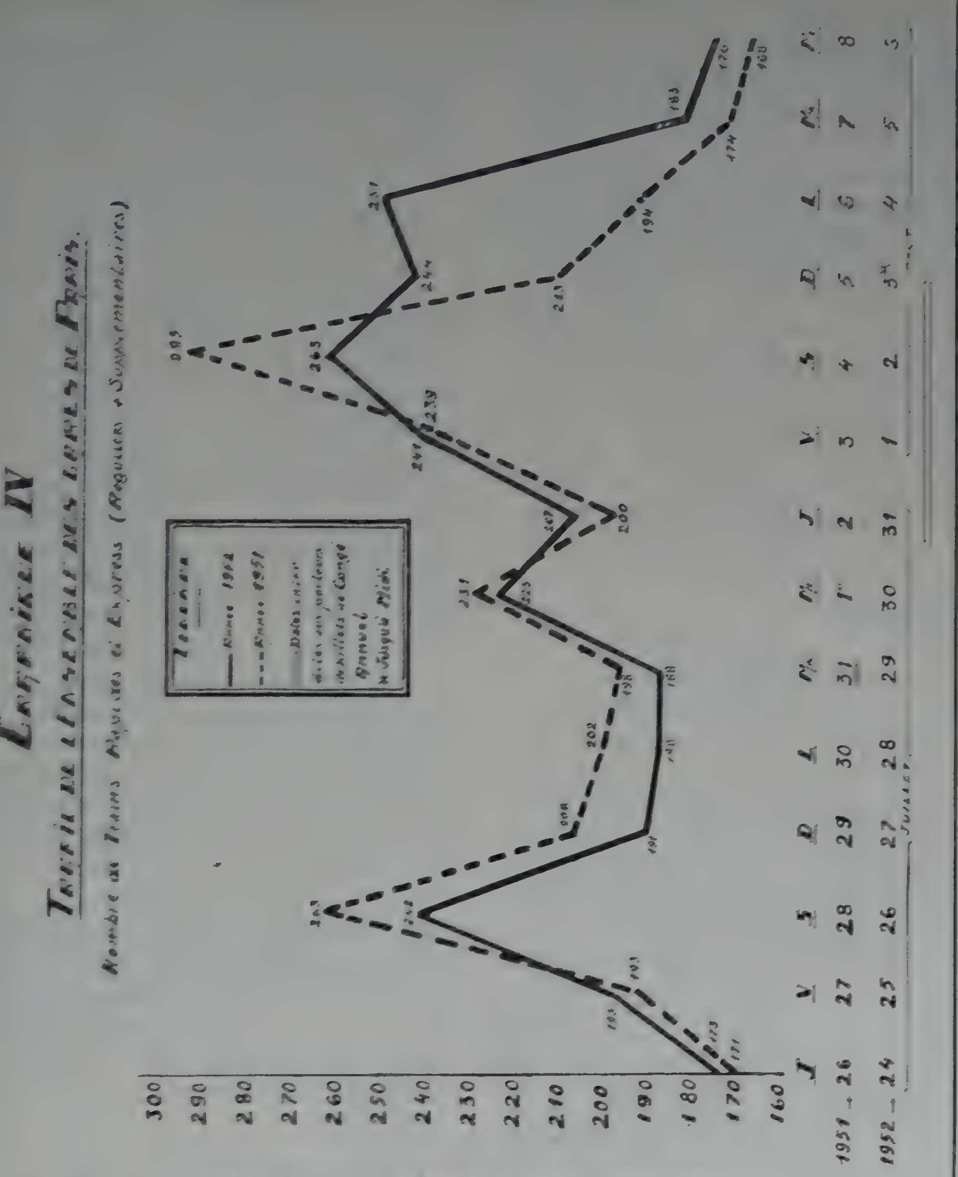
5 200 metal bogie coaches,
1 700 wooden bogie coaches,
7 090 non-bogie coaches,
i.e. a total of 14 050 coaches in all.

The stock as a whole has therefore decreased by 14 350 coaches, i.e. about 50 % compared with 1939, i.e. 23 % of the bogie stock and 63 % of the non-bogie stock.

As will be seen, the very appreciable reduction in the stock has not concerned the metal bogie coaches, but on the contrary the number of coaches of this type has increased by 1 100 units; this is due to the fact that the S.N.C.F. has undertaken since its creation and pursued since the end of hostilities the metallisation of the wooden bogie coaches, for which such metallisation is of proven



Graph. III. — Average user of passenger trains — 1952.



Graph. IV. — Traffic figures for all the Paris stations.
Number of fast and express trains (Regular and Supplementary).
Legend : —— 1952.
– – – 1951.
═ Dates on which holders of annual holiday tickets are not allowed to travel.
* Up to mid-day.

value. It is thanks to these efforts that to-day from this point of view we are definitely in a better position than in 1939, in spite of the considerable reduction in the stock.

However, the needs of rolling stock required to cope with the passenger traffic which in 1952 amounted to 28.5 thousand million passenger-km, about 26 % higher than that of 1939, are still very great; these requirements are (excluding the suburbs of Paris, whose needs — 1 300 metal bogie coaches — remain practically constant) :

in normal times (Winter period):

	5 000 bogie coaches,
	5 000 non-bogie coaches,
i.e. a total of	10 000 coaches in all.

during the summer peak :

	7 300 bogie coaches(1)
	6 900 non-bogie coaches,
i.e. a total of	14 200 coaches in all.

(1) of which 6 700 for fast and express trains.

As a result of this situation, the present stock is sufficient for the normal traffic to be worked under good conditions with metal coaches only in slack period, but at times of heavy traffic, especially the peaks, the fast and express trains absorb not only the whole of the metal bogie stock but nearly all the wooden bogie stock, and it may even happen that it is necessary to use non-bogie coaches for a few short distance trains.

In order to improve this position as far as financial possibilities allow, the future programme of the S.N.C.F. covers the construction of a certain number of new metal bogie coaches, all of the weight-reduced type (36 to 39 t.) in order to make it possible to work all the regular and seasonal fast and express trains shown in the timetables with this stock, only using the wooden stock for short distance fast and express trains (300 km — 186 miles) at peak periods.

With this object in view, between 1946 and 1950 inclusive were built : 750 metal coaches; 130 others were ordered in 1952; the S.N.C.F. intends, if its financial resources allow, to continue with such constructions at the rate of 200 metal coaches a year, until the above figure of 6 700 coaches has been achieved.

For financial reasons, however, there can be no question of acquiring sufficient stock to deal without difficulty with all the traffic likely to occur; according to recent calculations, if special steps had not been taken, it would be necessary as far as the rolling stock in particular was concerned, to order at least another 600 coaches, representing at the rate of an average of 30 million francs per coach a sum of 18 thousand million francs; these coaches would only be used during a period of some 30 days a year, and would be standing idle the rest of the time.

The S.N.C.F. could not contemplate such an expenditure, which would be even less profitable in view of the fact that such stock would only be used to accommodate summer passengers travelling at reduced rates, and generally all in one direction at a time.

3°) Special measures.

For this reason the S.N.C.F. has been led to take special technical and rating measures, applicable at peak periods, all intended to *spread out* the traffic.

These measures include :

a) representations to the Public Authorities;

b) restrictions on travelling by certain trains;

c) the suppression of certain transport at certain dates.

a) *Representations to the Public Authorities.*

An active campaign has been waged for several years with the ministerial departments concerned and with the administrations, industrialists and large undertakings to get the annual paid holidays staggered. A circular from the Minister of Works dated the 1st April 1947 (see *Appendix* further on) has given various directives in this connection which completely meet our views.

As regards school holidays (and this led to much heated discussion) we have had a great victory. The dates for 1953 have been fixed from the 28th June to the 18th September instead of from the 14th July to the 1st October. As a result the month of July like the month of August will be a holiday month throughout, and it is likely that the traffic peaks of the 13th July (which precedes the national holiday of the 14th) and the end of July will be considerably reduced.

It should be the same as regards returning from the holidays during September.

As regards the annual holidays with pay, we have been able to carry out investigations with the industrial and other large undertakings of the Paris Region which have led to certain results; for example the Renault and Citroën factories are staggering the dates of their holidays by several days; Renault are even looking into the possibility of closing down during the month of July instead of August; the new school holiday dates cannot fail to encourage this proposal.

However in this connection, persuasion has little effect as it comes up against very old customs; therefore we are obliged to get the traffic staggered by other more effective means.

b) *Restrictions on travelling by certain trains.*

First of all, all the fast, express and through trains in France now have a limited number of seats; this measure is more theoretical than practical, but it gives the legal right to refuse when necessary demands for seats on trains which could not be doubled at the last minute.

But the most effective measure is to forbid the holders of certain tickets issued under special tariffs to use certain trains and railcars at certain dates. For example :

— holders of cheap return tickets were not allowed in 1953 to travel on the fast and express trains and railcars on the 31st July, 1st and 2nd August from Paris, and on the 1st August from other places;

— holders of group, conference and holiday camp tickets were not allowed in 1953 on the fast and express trains and railcars leaving Paris on the 10th, 11th, 12th, 30th and 31st July, 1st, 2nd, 3rd and 4th August, to Paris on the 29 th, 30th and 31st August and in other places on the 11th, 31st July, 1st, 30th and 31st August;

— the issue of tourist tickets is suspended between the 25th July and 15th August and from the 20th December to the 1st January, and the outward portion cannot be used on Fridays and Saturdays of the weeks before Palm Sunday and Easter;

— the holders of tickets « Valid Sundays », « Week-end » and workers returns are not allowed on certain trains. All these restrictions are given in the General Information of the Timetables.

Side by side with these restrictions on ordinary passengers, there are special restrictions in the case of holders of free passes (employees and their families). They are not allowed on certain trains or railcars, either permanently or at certain times; in general, these trains and railcars are those where it might be necessary to double the train or replace the railcar by a steam train if they were allowed on them; these special restrictions are explained in a service notice issued to the staff.

c) *Suppression of certain transport at certain dates.*

The pilgrim trains to Lourdes (510 during the year 1952) mean that the S.N.C.F. has to set aside for this purpose 17 rakes in internal traffic and 7 rakes for international traffic; these rakes are pooled and their runs so arranged as to obtain the maximum output. In order to have as many coaches as possible available for ordinary passengers at peak periods, those used for internal traffic are suppressed from the 25th July to 15th August.

During the same period, the special complete trains to holiday camps are not allowed at the most critical dates; however the Regions can, if they have the necesary stock available, run trains of this sort provided they can be run outside the most heavily loaded hours.

Finally, we have not reintroduced the special holiday trains granting reduced fares with the right to return as required, as this formula led to a great deal of light runs.

4°) **Reservation of seats.**

Finally, a very effective method for the proper flow of traffic at all seasons, especially during peak periods is to have a highly developed system of seat reservations.

Such an organisation has a double object in view :

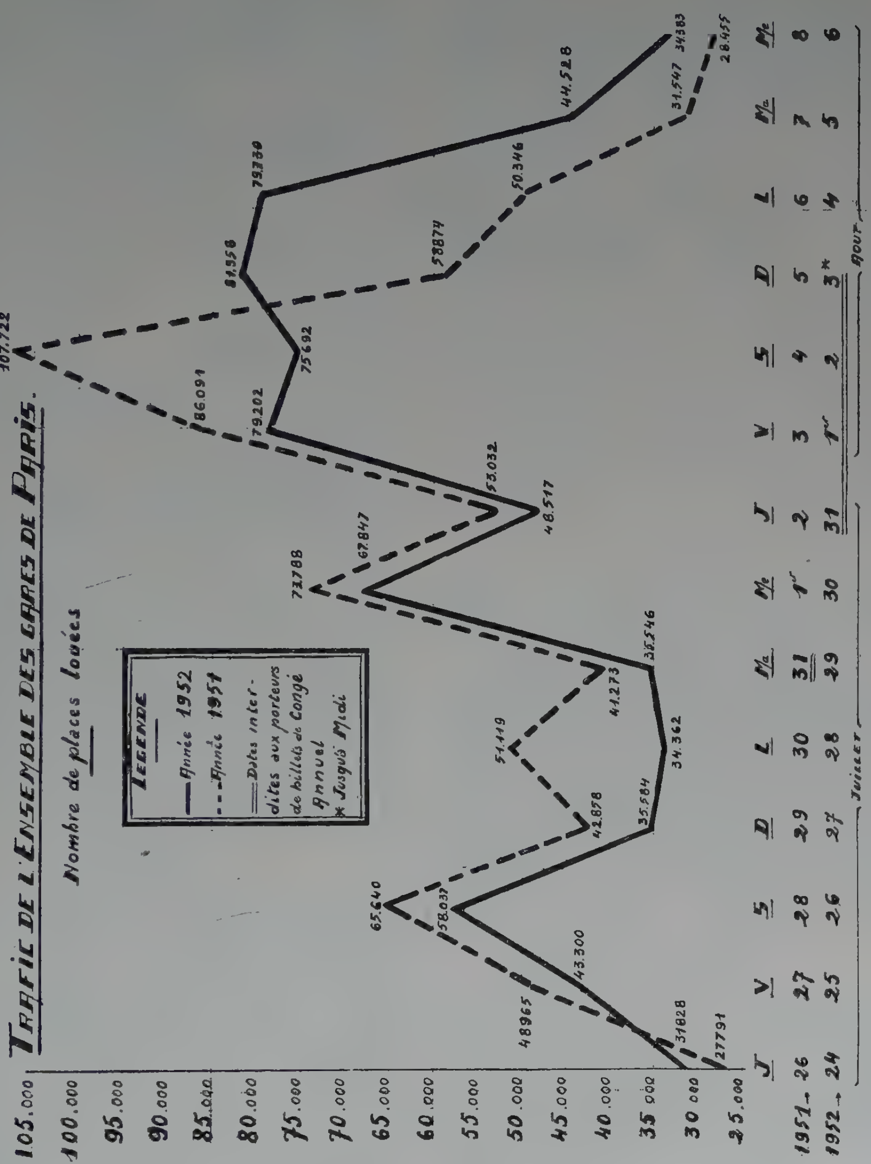
a) to facilitate travelling for the public by assuring passengers of a seat without having to queue up for the trains a long time before they leave;

b) to allow the S.N.C.F. to know as exactly as possible in advance the number of passengers going to travel, so that they can adapt the number and composition of the extra trains run at peak periods accordingly.

It was with this double object in view that the S.N.C.F. has developed the reservation of seats to the greatest possible extent provided for by the station installations and the development of telephone lines. Such reservation can be made either directly at the office in the station and at agencies or by letter or telegram, or by telephone.

The General Information included in the Timetables devote a special paragraph to reservations, the method of application, expecially the time limits within which they will be accepted.

This organisation has been extremely well received by the public; in certain districts (Cote d'Azur, Savoye, Cote



Graph. V. — Traffic figures for all the Paris stations.
Number of seat reservations.
Legend : —— 1952.
- - - 1951.
═══ Dates on which holders of annual holiday tickets are not allowed to travel.
* Up to mid-day.

Basque in particular), where the development of the telephone installations made this possible, we have had to organise « Reservation Centres » which are connected by telephone to all the stations or agencies in the district, so that at such stations and agencies passengers can reserve seats immediately just as if they were at a station with a Reservation Office. In addition, the Paris-Lyons station which is the station in Paris most frequented by long distance passengers, has been equipped with a central service of this kind which can accommodate 12 operators at peak periods and issue more than 20 000 reservations a day, its capacity being limited only by the number of seats available on the trains.

Graph V shows for periods lying between the 26th July and 8th August 1951 and 24th July and 6th August 1952 the number of reservations for all the stations of Paris; it shows that our reservation organisation found it possible in the case of the departures on the 4th August 1951 to issue in Paris nearly 108 000 reservations, and in 1952 in the case of departures from the 1st to 4th August inclusive, we were able to issue in Paris a *daily* average of about 79 000 reservations.

IV. RESULTS OBTAINED

Graphs II, IV and V show the results obtained.

Graph II, which gives the main line passengers leaving from the Paris stations in 1951 and 1952 during the « end of July — beginning of August » period, and also the dates on which holders of cheap annual holiday tickets are not allowed to travel, shows very clearly that thanks to all the measures reported above, the peak of the 4th August 1951 with its some 250 000 passengers did not occur again in 1952, but on the contrary this peak period was spread out over 4 days, from the 1st to the 4th August inclusive, during which we had each day an average of 180 000 passengers leaving Paris.

Graph IV, which shows the number of fast and express trains leaving Paris during the same period, shows the same results; the peak of the 4th August 1951 with 295 trains did not re-occur in 1952, but this peak was spread over 4 days, from the 1st to the 4th August inclusive, during which we had about 250 trains leaving Paris daily.

Graph V, which gives the number of seat reservations for the same periods, in the Paris stations, shows the same trend.

The desired results were therefore obtained; we have succeeded in spreading out the peak traffic around the 4th August 1951; this result has led to very considerable savings; it has also made it possible to assure the flow of traffic remarkably regulary; finally the public have enjoyed a better service.

CONCLUSION

As I have already indicated in the report which I presented to the 14th Session of the Railway Congress at Lucerne in May 1947 (*), the flow of peak passenger traffic is one of the greatest operating difficulties for the railway. It is essential, in our opinion, to reduce such peaks, unless they are to be allowed to burden to an impossible extent the passenger service balance-sheet. Moreover, Railway Administrations as a whole have not the ne-

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(*) See *Congress Bulletin* for the month of January 1947, p. 29.

cessary rolling stock to give services « on demand »; they cannot afford the important capital expenditure that would be necessary to do so.

We have shown the steps taken by the S.N.C.F. to solve the problem of peak traffic; the results obtained are very encouraging and the steps taken to obtain them, which are in fact measures containing a certain « direction » are acceptable; we are going to continue on these lines.

APPENDIX

MINISTRY OF WORK — Official Documents.

General Management of Work and Labour.

Management of Work.
Sub-Management of Wages and Working Conditions.

3rd Office.

(Circular TR 028/47 of the 1st April 1947, concerning the spreading out of holidays with pay in 1947.)

THE MINISTER OF WORK AND SOCIAL SERVICES,
to the Divisional Inspectors of Work and Labour,
and to the Departmental Managers of Work and Labour.

In Circular TR 32/46 of the 30th April 1946, I asked you to encourage agreements between employers and workmen's organisations in order to spread the period of holidays with pay over as long a period as possible.

According to the information I have been given, the custom of those enjoying holidays with pay of leaving for their holidays at the same time of the year, especially between the 1st and 15th August was in no way altered last year, and the firms granting holidays to all their employees by closing down most often, especially in the Paris area, chose to close down during the first fortnight in August.

The usual drawbacks of this state of affairs was also experienced : the overloading of the methods of transport and the hotels of the holiday places. The S.N.C.F. report, in particular that in order to meet such a sudden influx of passengers at these peak periods they have had to include old types of coaches in the fast and express trains, which have not always the standard of safety and comfort desirable

It is therefore necessary, to avoid to the greatest possible extent a repetition of this state of affairs during the holiday season of 1947, to take two series of measures, according to whether the holidays are granted in rotation, or whether the holidays are given by closing down the undertaking.

I. — FIRMS GRANTING HOLIDAYS IN ROTATION

It is absolutely essential that you should immediately take all the steps you consider necessary in your area or your department to lead employers and their syndicates, workmen's organisations, the firms committees and the workers themselves to recognise that in the general interest and the interest naturally of those concerned there must be an agreed discipline in order to spread departure for holidays over as long a period of the year as possible. As you know, the holiday period must cover at least the period from the 1st June to the 31st October, but the indications given in this connection in article 54 *b* of Book II of the Code of Work are in no way limitative. It would therefore be all to the good if those workers who wished to take their holidays before the 1st June or after the 31st October could do so freely, even during the winter months.

I am not overlooking the fact the fathers and mothers of families will naturally wish to take their holidays during their children school holidays; but there are also a large number of workers who are not married or whose children have either left school or are too young to go to school who could take their holidays, and moreover enjoy much greater facilities by doing so, before the 14th July of from September. Moreover this latter month is always available for those with children of school age.

Consequently you should make use of all the methods of propaganda at your disposal, especially the press, to bring to the knowledge of all workers, employers and the organisations concerned in your area or department, the inconvenience caused on the one hand by mass departures during the holiday period, and on the other the advantages which spreading departures over a longer period entails for holidaymakers.

A. *Inconvenience of mass departures at peak periods.*

The consequence of the habit acquired by the inhabitants of large towns of taking their holidays during the month of August and leaving for their holidays at the beginning of this month has been explained many times in the circulars dealing with this question. The month of August, although not always the finest and warmest, for some inexplicable reason attracts holidaymakers who rather than consider an earlier or later date for travelling prefer to travel in extremely unsatisfactory conditions as regards comfort and even safety, crowd into the hotels and boarding houses and overcrowd the holiday towns which cannot feed them satisfactorily, and finally have to pay for everything at higher rates.

. . . .

B. *Advantages of spreading out departures outside the peak periods.*

First of all it is obvious that the inconveniences listed above do not occur in the case of persons taking their holidays at other periods than the peak periods, especially before or after the months of July and August. It is an undoubted fact that the months of May and June for example are very suitable for restful holidays.

Moreover, you can already make known the representations the organisation « Tourism and Work » have made to the S.N.C.F. on the one hand and the hotel keepers on the other. « Tourism and Work » organises group travel during the so-called slack periods and enables their clients to profit by very advantageous railway and hotel charges. For these same periods « Tourism and Work » makes agreements with hotel keepers enabling individual holiday makers and their families to enjoy lower rates than the standard charges for visits during the months of July and August.

II. FIRMS GRANTING PAID HOLIDAYS BY CLOSING DOWN

Such closings down nearly always take place at the same period, and nearly all during the first fortnight of August. The result is that the workers of the firms in question come to the railway booking offices in a mass and all arrive together at the holiday resorts.

It would therefore be particularly desirable to make representations to employers and their syndicates, working committees, workmen's unions, and as far as possible, to the workers themselves to arrange for :

— employers to stop closing down their premises unless this is absolutely imperative, and instead grant holidays in rotation;

— closing down dates to be chosen outside the peak periods — especially the first fortnight of August — and not to correspond with the dates given by the S.N.C.F. as enumerated above;

— that the closing down dates of different groups of firms should not all be the same;

— that the dates should be fixed in such a way that there is a spread of a week in the firms belonging to one and the same group, who should endeavour to accumulate a sufficient stock of raw materials to enable them to carry on production during these few days. In this connection, I am considering giving you wider legal powers than those you now have, so that you are in a position to control the choice of dates at which different firms close down.

. . . .

The Minister of Work and Social Security,
A. CROIZAT.

[625 .173]

Mechanisation of permanent way repairs,

by Josef Weig, Abteilungs-Präsident and Wilhelm Gasser, Reichsbahnrat, Munich.

(*Der Eisenbahn-Ingenieur*).

The reduction of renewal work on the German railway system during the six years before the second world war, during the war, and since the war, has resulted in considerable arrears which now have to be made up. Taking it that 4 % of the first class lines and 10 % (8 % since 1952) of the track equipment laid in these first class lines, have to be renewed annually, the arrears in the Federal territory would appear to be at the end of 1952 some 14 000 km (8 700 miles) of line and about 38 000 track apparatus.

As this problem, which is becoming increasingly serious, simply must be solved, the next ten years must include very considerable permanent way work over the whole German federal system.

With the usual renewal methods, the multiplication of working sites on the main lines would enormously hinder the working, and very considerably affect the economics of carrying out the work which would be greatly slowed down owing to the heavy amount of traffic.

Thanks to the rapid progress made in recent years in the mechanisation of permanent way work, there are some machines available for this work having a very high output. As at the same time, very promising methods of construction, such as concrete sleepers and rails welded into long lengths, have successfully passed their practical trials, conditions were available for ensuring the renewal of the track *rapidly, economically and to a high technical level.*

At several working sites that were completely mechanised for laying concrete sleepers and long rails on lines of the exceptional category on the system covered by the Munich Management, thanks to very close collaboration between all the departments concerned the results obtained have resulted in the relations between the permanent way and operating departments to be looked at from a new point of view in the case of wide scale renewal work on lines with very heavy traffic.

I. The machines needed for work on the permanent way.

We have no intention, owing to the scope of this note, to give details of the construction of existing machines nor discuss future inventions. These have been the subject of several descriptions recently in different technical publications. The list given below is only a synoptic table intended to facilitate understanding of the report that follows by giving the hourly output.

1) *Cleaning the ballast :*

a) « Scheuchzer » screener : output 30 to 40 m (33 to 44 yards) /h;

b) « Matisa » screener : output 60 to 80 m (66 to 87 yards) /h.

2) *Taking up the old track :*

a) « Niemag » crane for laying the track (15 m [16 yards] rails only); output : 120 to 160 m (130 to 175 yards) /h;

b) « Arneke » gantry crane (for rails of any length); output : 120 m (130 yards) /h.

This equipment includes transport trains composed of flat wagons, which are fitted, if necessary, with tracks so that the locomotive can bring the sections of track to the site;

c) « Ardelt » pivoting crane; output :

80 to 100 m (87 to 109 yards) of permanent way materials per hour;

d) Cranes for laying the track equipment, enabling complete units to be laid or removed.

3) *Works on the bed :*

a) « Hanomag-Frisch » leveller with special shovel; output : 100 to 120 m (109 to 130 yards)/h;

b) « Losenhausenwerk AT 5000 » vibrating compactor; output : 120 m/h;

c) Light and heavy ballast rollers, 5 to 7 t; output : 120 m/h.

4) *Preparing lengths of ballast to take the reinforced concrete sleepers :*

a) « Arneke » machine, hand operated; output : 50 to 60 m (55 to 66 yards)/h;

b) « Arneke » machine, motor driven; output : 200 m (219 yards)/h.

5) *Laying the sleepers :*

a) « Arneke » gantry cranes (for laying sleepers of any length); output : 90 to 120 m (98 to 130 yards)/h;

b) Machines for laying different types of concrete sleepers; output : 80 to 180 m (87 to 196 yards)/h.

It is sometimes possible to increase the output by motorisation and by having several machines working at intervals on the site;

c) « Arneke » gantry for the displacement of rails of any length;

d) « Robel und Esma » coachscrewdrivers for inserting and removing coachscrews; output : 500 to 800 coachscrews an hour.

6) *Ballasting the sleepers :*

a) « Matisa » tamper; output : 90 to 120 m (99 to 130 yards)/h;

b) « Krupp » tamper; output of the gang : 25 to 40 m (27 to 43 yards)/h;

c) « Jackson » tamper; output : 20 to 30 m (21 to 32 yards)/h.

7) *Welding the rails :*

By increasing very considerably the number of men in the aluminothermic welding gangs, and by improving their equipment, by lighting installations, and also by the motorisation of the vehicles used by the gangs, welding can be carried out very quickly when renewing long lengths of rails, when it is done immediately behind the gang laying the rails and does not involve any additional disturbance to the working. The welded joints are then planed by means of a motor driven machine (output : 4 to 6 joints an hour).

Very thorough metallurgical studies of the phenomena of welding and the systematic perfecting of the professional skill of the welding gangs, have in recent years improved the welding done to such an extent that it can be said that the rails are joined up practically homogeneously. No accidents have occurred, even with the highest rail temperatures. Work is being continued on developing new methods of welding and perfecting the aluminothermic process.

The number of gangs carrying out running repairs has also been increased and their technique has been so improved that in many cases damage to rails and the frogs of crossings can be repaired on the spot without interrupting the working.

8) *Maintenance of the track :*

Mechanisation is also being extended in the case of the maintenance of the track. According to the amount of traffic on the line, use is being made more and more of mechanical tampers running on the track, or portable motor tampers. As soon as a sufficient number of these machines has been acquired, the work as a whole will be rationalised (use of working units so as to form entirely mechanised maintenance gangs). This will enable considerable savings to be made and lead to an increase in the output of methodical maintenance.

All the different Managements are making use of specially designed sets of equipment for drilling the wood sleepers. New machines have also been designed for shovel packing sleepers with fine gravel.

II. Organisation of a completely mechanised working site.

These powerful machines and equipment have considerably altered the traditional aspect of a working site on the line and the corresponding organisation.

The machines used successively in the order in which the different operations take place, assure continuous progress and a relatively high hourly output, and result in a new stretch of line which can be run over without any reduction of speed. The aim of those in charge of the work should be to maintain *by all possible means the continuity of the work* and avoid and eliminate any interruptions on the site. If certain gangs are getting in each others way, this must be noticed and rectified immediately (fig. 1).

As soon as the work is planned in the offices of the Permanent Way Department, the slightest details required for a regular progression must be noted and made quite clear in the *detailed programme for carrying out the work.* Such problems as stabling the work trains and gangs, which are generally large, in the neighbourhood of the work, the organisation of a site for dismantling the materials taken up, the organisation of an area for assembling the new material, the servicing of the site for (regular !) work trains, the fixing of the working posts and the orders given to the gangs, the provision of spare equipment, the order in which the different jobs will begin, lighting by night, the installation of telephonic communications alongside the site, etc., are all problems that must be solved in advance. As the different Operating Regions have at the present time no practical experience of completely mechanised working, the offices of the Permanent Way Department have to undertake most of this preparatory work. However, the specialists of the different Regions and the Heads of the Permanent Way Departments must take part in the provisional studies in order to be able to hand over this work to the local services.

At the beginning it would be wise to entrust the remaking of large sections only to specialists (working parties or qualified contractors) with some experience of the working of a completely mechanised site. In principle, all the machines are worked solely by operators who remain with them all the time and are themselves able to carry out any small repairs needed.

The *timetable of the work,* drawn up in collaboration with all the Departments concerned, should be got out in the form of an easily understandable graph. Each operation should be shown by a chronological band. If the organisation of the work is very complicated, each phase must be made quite clear with if necessary the time at which the work trains will run. The programme should be reported to the management staff (fig. 2).

It appears useful to call a *conference of all the Departments concerned* in the work: Permanent way Department, contractors, staff operating the work trains, local working managers, overhead line maintenance department, signalling department, welders, etc., in order to notify them of the objectives in view and draw their attention to any difficulties foreseen. In this way, mutual understanding is facilitated as well as the mutual comprehension of the difficulties experienced by the other departments, and greater understanding and collaboration obtained from each. This conference can also be used to raise once again the question of the prevention of accidents.

Experience has shown that even with a minutely detailed preparation of the work, it is necessary to set up a central organisation to which all the threads of the work and the management of the work will lead (fig. 3). This *central post* which must always be set up at the strategic centre of the work site, will be in charge of a qualified employee (operating engineer or permanent way official together with a

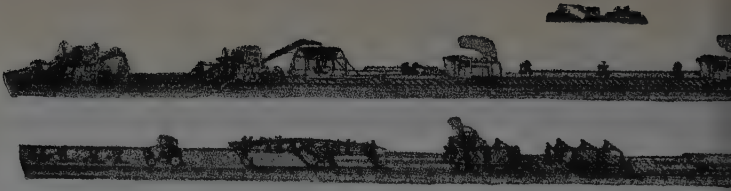


Fig. 1. — Diagrammatic repres

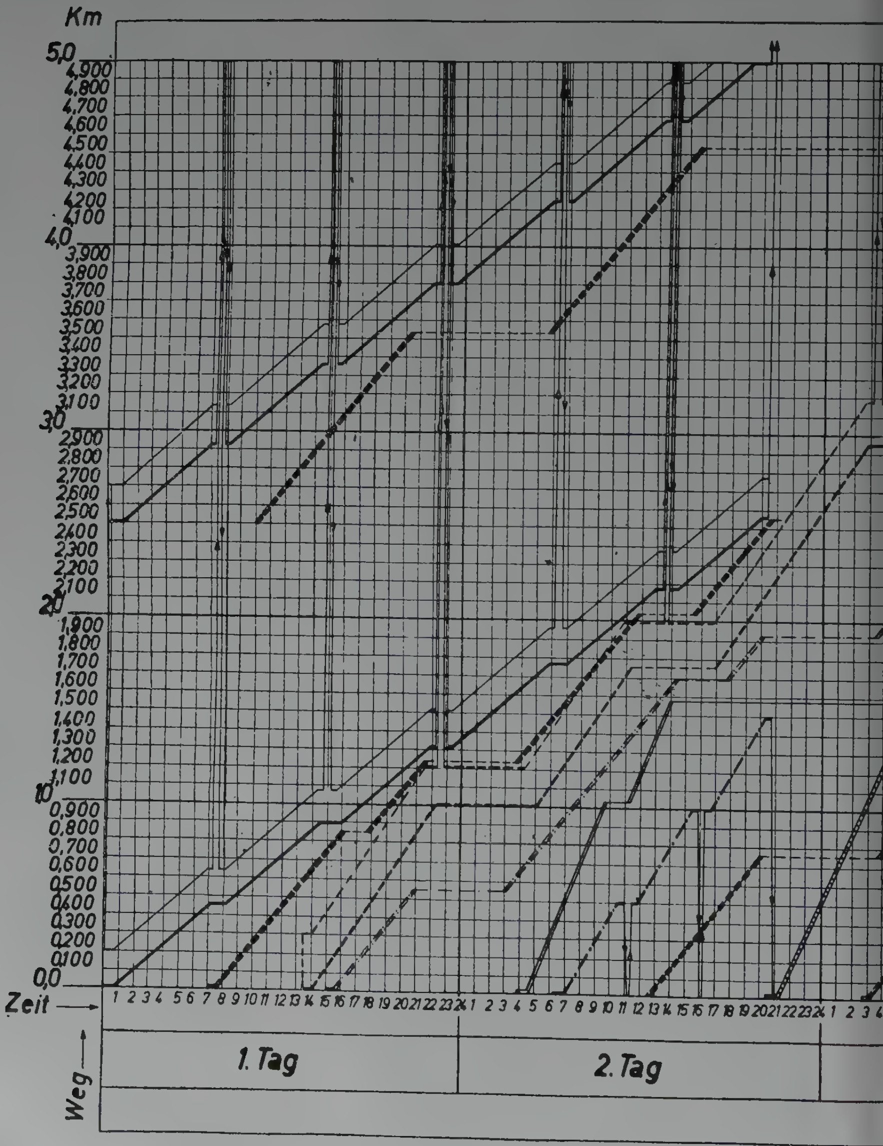


Fig. 3. — Graph showing the carrying out of completely mechanised t

Tag = da

— Matisa ballast screening machine with transport train. Output 65 m (71 yards)/h.

— Laying the running track 100 m (109 yards)/h.

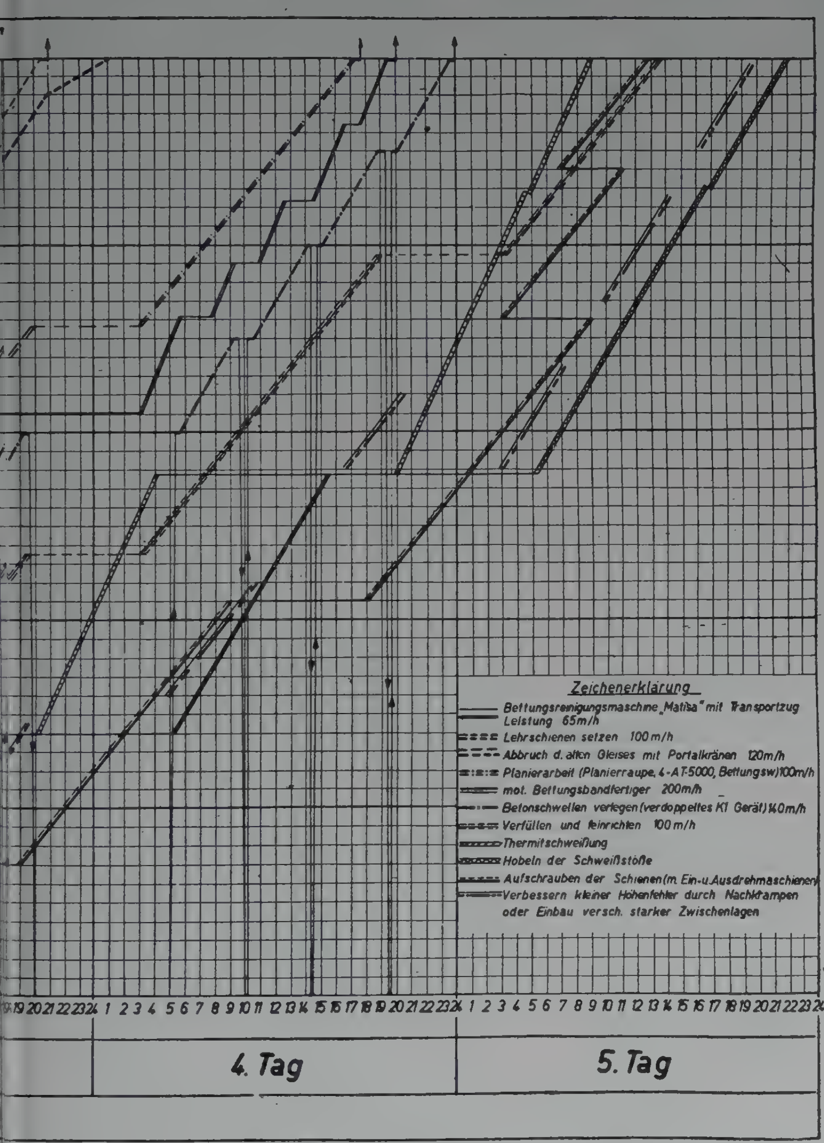
— Removing the old track with gantry cranes 120 m (131 yards)/h.

— Levelling (4:
rollers. 100 m

— Machine for
yards)/h.

— **Laying concre**
140 m (153 ya

ely mechanised working site.



ncrete sleepers and long rails. 5 km (3 miles) in 5 working days.

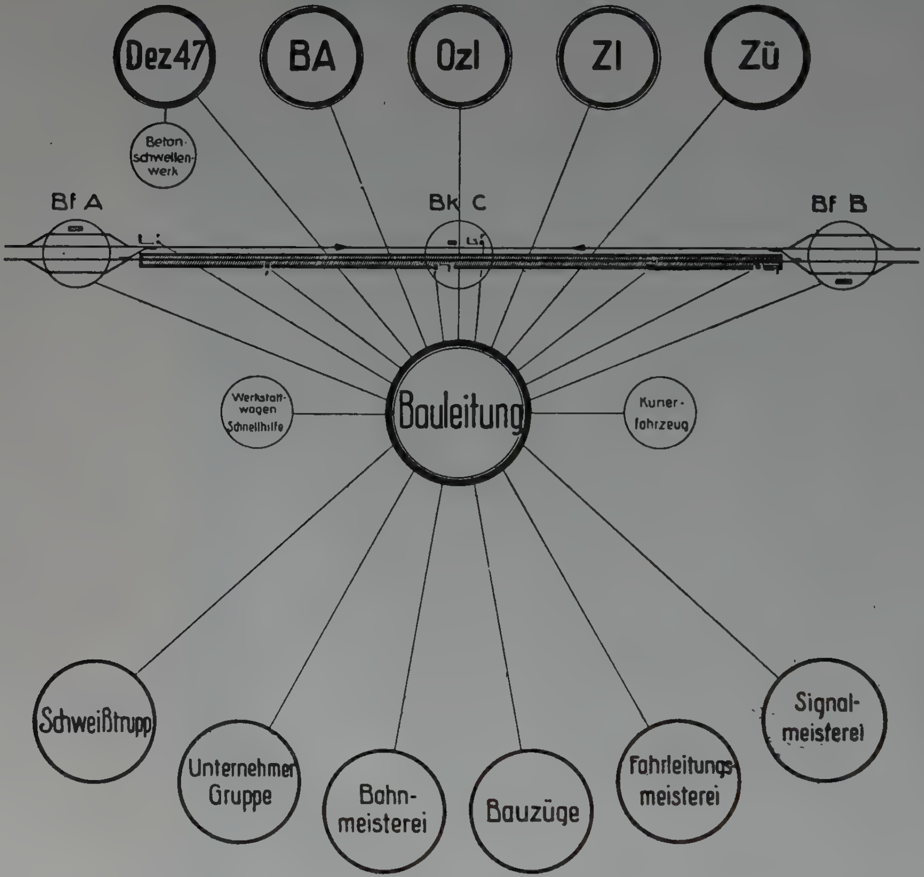
ion E.

hine, ballast

200 m (218

machine)

— Tamping and adjusting 100 m (100 yards)/h.
— Aluminothermic welding.
— Planing the welded joints.
— Coachscrew driving (coachscrew driving machines).
— Touching up slight defects by tamping or fitting different thicknesses of bearing plates.



Welding and running of the work train on the line being remade. Modification of the programme owing to atmospheric conditions. Provisional fishing of the joints, etc.	Observation of the allocated time. Distribution of the working posts. Number of men in the gangs. Control of output, etc.	Look outs. Work trains. Speed restriction signals. Bringing up materials. Prevention of accidents, etc.	Removal and breaking up of material taken up. Harmonisation of the production of the different gangs. Servicing the machines, etc.	Cuttings of current. Regulating the overhead wire according to the level of the track. Reconnecting the current on the line being renewed.	Modification of the connections to signals. Line contacts. Interlocking gear. Additional blocks, etc.

Fig. 2. — Organisation graph of a completely mechanised working site.

Explanation of German terms:

Bf. A = station A. — Bauleitung = direction of work. — Werkstattwagen Schnellhilfe = wagon-workshop for first aid repairs. — Kurierfahrzeug = vehicle from which orders are given. — Dez 47 = service 47 (service of the Management of the permanent way. — B. A. = operating region. — Ozl = central control post. — Zl = regulating post. — Zü = control post for the train services. — Schweisstrupp = welding gang. — Unternehmergruppe = contractor's gang. — Bahnmeisterei = section of the track. — Bauzüge = work trains. — Fahrleitungsmeisterei = overhead wire department. — Signalmeisterei = signalling department regional official) and will be equipped with as convenient as possible means of telecommunication (in addition to the usual telephone, the first trials made with portable radiotelephonic equipment have given good results). The management of the work should not be in the hands of the head of the section of line in question, as he already has a whole series of other jobs to carry out when a line is being relaid. The central post will receive all the orders from the centre regulating post, from the local regulating post, the traffic control post, the Regional working and the head of the Permanent Way Department (47). All the gangs working on the site must be instructed to address all requests for information to this post only. Care must be taken that all the orders given are absolutely clear. It is useful if the management has a conveyance for distributing instructions. Only in this way can different working groups, often several miles apart, work in collaboration without getting in each others way. The chief task of the organiser of the work is to take steps *in advance,* notify the running of the work trains *in good time* to the operating department, prevent damage from the start and keep the work going continuously. A small mobile workshop attached to each department with a stock of spare parts can be rapidly taken where it is needed to repair any breakdowns. A small lorry, independent of the track, can be used successfully to distribute small parts, welding equipment, fuel, lighting equipment and supplies for the workmen.

The size of the stock of tools and the amplitude of the preparatory organisation methods may at first sight appear costly. However, with trained men the work keeps going without difficulty. Only in the case of unforeseen difficulties is any central management required, or again in the case of harmonising the progress of work of the different groups of men. The best justification of the cost lies in the output obtained, which exceeds 1 000 m (1 093 yards) a day. Such an output is not only obtained in the case of concrete sleepers, but results of the same order are also possible when renewing track with wood sleepers.

The absolute maximum output possible per working day appears to be 2 000 m. But to obtain this figure means working in two 10 hour shifts. In addition every operation must be closely supervised, including the removal of the track. An output of this order can only be obtained when the total length of the working site is at least 8 to 10 km (5 to 6 miles), otherwise the initial and final operations will nearly overlap and continuous work is never possible in practice. It is not advisable to work in three shifts on large sections, because there are always small touching up jobs and repairs to machines which must be carried out between the normal working shifts in order not to upset the continuity of work.

III. Contribution of operating department to the method of rapid renewal.

It is not only in the structure of the technical organisation that mechanisation has caused a revolution. It has also led to essential modifications in the relations between the Permanent Way and Operating Departments when lines with heavy traffic have to be renewed.

Up to the present, it has generally been necessary above all to take into account operating necessities and renew the track almost under the trains by manual work made almost endless by the constant interruptions due to the working. Completely mechanised renewal of the track, with its powerful machines, requires on the contrary different working conditions if its full advantages are to be realised.

Although everything possible is done to make use of the machines laying the track during the short intervals between trains (about 3 hours), the number of machines involved means the closing down of the section without interruption for the whole working period. In this way 5 to 6 km (3 to 4 miles) of the running line between two stations can be completely renewed in 5 to 6 days and then opened to traffic without any restrictions.

From the point of view of the work, the method is still more powerful and economic when longer sections of line can be freed for a short period.

Undoubtedly this imperious necessity involves the management and operating departments when working in much greater difficulties than the old method, and it can be well understood that with five sections of renewal of track with concrete sleepers and long rails proposed for the exceptional lines of the Munich Management, very thorough studies had to be made from the working point of view to prevent all inadmissible risks. Thanks to the excellent collaboration between the operating, the traction, the traffic and the permanent way, all the working sites (2 of which were on the Munich-Augsbourg line which is run over by more than 190 trains a day) were successfully carried out without any friction, whilst respecting the time limits imposed. This proved that it is possible to organise single line working even on lines with very heavy traffic under difficult conditions (suburban services and grouped express trains). We would like to draw special attention to the additional work imposed on the operating because of diversions and other provisional measures intended to ensure the successful carrying out of the work. In the same way, work carried out in the stipulated time by the traction and overhead wire sections has greatly contributed to the success of the renewal work.

It is not yet possible to draw up a uniform scheme applicable to the organisation of single line work or the temporary closing down of a single track line. There are such great differences between the different regions from the point of view of the development of the lines, the density of the system, the amount of traffic and the traffic requirements which must be studied individually in each case.

Amongst the numerous provisional measures which it is possible to introduce in order to relieve the lines to be renewed, we will merely mention :

the diversion of the through goods trains;

the diversion of long distance express trains running at their appropriate times;

the suppression or amalgamation of certain stopping trains;

temporary modification of the times at which local trains run;

the substitution of road services for the trains and limiting the stopping goods trains.

By advising the operating and traffic departments as soon as the preliminary studies of the organisation of the work are begun, all those concerned have a chance to study the situation. In every case, it has been found that when they are advised in advance by means of pamphlets, articles in the local papers or circular letters, passengers and consignees are very understanding when it is a question of temporary arrangements intended to improve the line. The local road authorities always hold up the traffic and arrange temporary diversions when renewal work is being carried out and everyone considers this a necessary step.

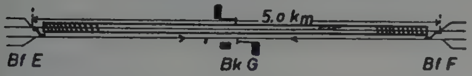
IV. Economic limits of the process.

Completely mechanised renewal of the permanent way in the case of lines with very heavy traffic involves the diversion of trains and consequently a greater burden on the working and transport than in the case of work carried out in the short intervals between trains, so that it is necessary to determine both the cost of construction and of working in order to ascertain the economic limits of this process.

Experience has shown that local circumstances are so diverse that an approximate economic calculation must be made in each individual case.

To give some idea of the approximate value of the cost involved, we will try to calculate the cost of a hypothetic working site 5 km (3 miles) long between two stations on a double track main line. In this comparison, we will give each time in the calculations figures obtained a posteriori or empirical values very close to actual conditions, so that the picture will not be in any way distorted.

1. *Hypothesis :*



2. *Daily traffic on the line :*

In both directions of running:

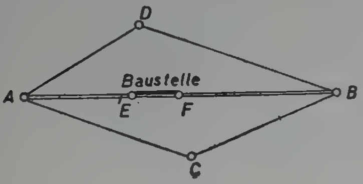
12 express trains	passengers;
20 stopping trains	

40 through goods trains;

1 section train;

or a total of 146 trains.

3. *Possibilities of diverting trains :*



Between A and B, the trains can be diverted via C or via D. Let us suppose that the additional mileage due to this diversion is 20 km (12 miles). There will have to be diverted :

35 through goods trains in both directions;

2 express trains in both directions.

Five stopping passenger trains will have to be suppressed in each direction, or amalgamated with other trains. There will therefore remain a total of 62 trains on the section of single track line E-F covered by the work.

4. *Calculation of the cost of carrying out the work :*

a) *Renewal of the line completely mechanised with concrete sleepers and long rails, including cleaning the ballast.*

Time taken to do the work : 5 days.

Number of working days required per kilometre : 1 250.

This figure corresponds to the results actually obtained on the Olching-Langwied section carried out in 1952, taking into account all the supplementary work required for the organisation of single line working, work to the overhead wire, to level crossings, holidays, wet weather, etc.

Additional cost of diverting the trains, according to the figures given by the Regulations on the calculation of costs (« Beko ») :

Expenditure heading	Express train, total load : 600 t.	Goods train (thr.), total load : 800 t.
Train staff	0.35 DM/km	0.48 DM/km
Traction staff	0.35 »	0.60 »
Operating materials	0.99 »	1.07 »
Servicing of traction engines	0.15 »	0.19 »
Maintenance of traction engines	0.44 »	0.51 »
Sinking fund for traction engines	0.21 »	0.22 »
Maintenance of wagons	0.83 »	0.28 »
Sinking fund for wagons	0.30 »	0.11 »
Maintenance of the permanent way	0.51 »	1.15 »
Maintenance of buildings and works	0.49 »	0.75 »
Operating and supervising the line	0.65 »	1.09 »
Total	5.27 DM/km	6.45 DM/km

It must not be forgotten however that the basic figures of « Beko » have been obtained by the general inclusion of all charges and expenditure, in order to obtain the economic results of the D. B. Such accounts including all the expenditure involved in running a train give a false picture when used to determine the additional working costs momentarily needed on account of short duration work. A certain number of items should be completely overlooked, or only included in part. For example, the diversion of a small number of trains during a few days will not involve the earlier renewal of the bridges run over, the track installations nor the locomotives used; likewise it will not involve any additional staff. But as these items in the above summary represent a considerable proportion of the traction costs given by « Beko », only a proportion of these values need be included to give the additional local costs actually incurred.

A special study would be required to determine what expenditure must be included to ascertain the cost of these purely internal operating requirements. We think 50 % of the figures given above would suffice to cover the costs.

Naturally, in order to assure fairly important diversions without anything going wrong, the station and train staff will have to work harder for the time being, without however involving any considerable additional cost.

The cost of diverting 35 pairs of goods trains would amount to: DM

2 × 35 × 5 × 20 × 3.23 DM . = 22 610.—

Those due to diverting a pair of express trains to:

2 × 2 × 5 × 20 × 2.64 DM . . . = 1 056.—

Total, about DM 24 000.—

The additional cost due to slowing down trains at provisional junctions (according to the graphs relating to supplementary expenditure on train services due to speed restrictions).

To brake 10 express trains of 600 tons twice from 100 km (62 miles)/h down to 50 km (31 miles)/h and then accelerate again: DM

2 × 10 × 5 × 7.5 DM . . . = 750.—

To brake 5 through 800 t goods trains twice from 60 km (37 miles)/h to 50 km (31 miles)/h and then accelerate:

2 × 5 × 5 × 1.00 DM. . . . = 50.—

DM 800.—

There are no particular extra costs in the case of the stopping trains since these stop at both stations.

Recapitulation :

Wages costs for the work on the line: DM

5 × 1 250 × 24 DM . . . = 150 000.—

Additional traction costs due to the diversion . . . . = 24 000.—

Additional traction costs due to the speed restrictions . = 800.—

Capital costs for the stock:

A = first cost = 500 000.— DM

n = probable life = 10 years

p = rate of interest = 6 %.

$$A \cdot \left(\frac{1}{n} + \frac{0.5\,p}{100}\right) = 500\,000 \times \left(\frac{1}{10} + \frac{3}{100}\right) = 65\,000 \text{ DM.}$$

Of this figure, about 1/8 can be ascribed to the working site or in round figures . = 8 000.—

Fuel and lubricants . . . = 3 400.—

Total, about DM 186 200.—

b) *Renewing the track by packing (Klotzverfahren) :*

Supposed duration of the renewal: 7 weeks.

Consumption of working days per kilometre : 1 950, including all supplementary work.

On a line with such an amount of traffic, this value is certainly not excessive, since the annual average for 1950 for track renewal was already 1 751 working days per kilometre. (For remaking the Olching-Maisach line by this method, 2 210 days/km had to be allowed for in the comparative plans.)

Additional costs for speed restrictions during the working period (determined from the graph) :

To brake 12 express trains of 600 tons from 100 km (62 miles)/h to 30 km (18 miles)/h and accelerate again : DM

12 × 49 × 9.00 DM . . . . = 5 290.—

To brake twenty 300 t stopping trains from 90 km (55 miles)/h to 30 km/h and accelerate again :

20 × 49 × 3.00 DM . . . . = 2 940.—

To brake forty-one 800 t goods trains from 60 to 30 km (37 to 18 miles)/h and accelerate again :

41 × 49 × 2.70 DM . . . . = 5 420.—

Total, about DM 13 650.—

Recapitulation :

Wages costs for the permanent way work : DM

5 × 1 950 × 24.00 DM . . . =234 000.—

Additional cost of speed restrictions . . . . = 13 650.—

Total in round figures DM 248 000.—

The fast mechanised method therefore reduces the cost of remaking by about 62 000 DM, i.e. a saving in round figures of 12 000 DM per kilometre.

This purely financial advantage does not appear extremely important in view of the total cost of the work, which is 875 000 DM, when we take into account the amount of machinery required and the radical operating measures that have to be taken. But it must not be forgotten that if the renewal work of the track properly speaking is mechanised, which results in a saving of more than half the working days formerly required, on the other hand a great deal of accessory work such as the preparation of the working site, the remaking of the bed, the distribution of the materials required, finishing off, level crossings, safety installations, appropriation of the working site, etc., has in both cases to be carried out by hand in the traditional manner.

V. Technical advantages.

The mechanisation of permanent way work makes it possible to do most of the heavy physical work by machines.

In addition, the chief advantage of the new rapid method with temporary single track working does not lie essentially in the lower average cost, but in the technical execution of the work which is perfectly done and of very high quality and takes a very short time. In spite of the very short time taken to do the work, when checking these lines with a recording coach the running qualities were found to compare with the best of the federal system.

The compacted and rolled surface of the ballast, together with the laying of the layer of ballast by machine guarantees with reinforced concrete sleepers a perfect initial foundation which can be still further improved by small touchings up at certain points before normal working is resumed. (By making good slight differences in level by means of poplar bearing plates of different thicknesses, it is possible to get very simply an excellent bed right from the start.) Good results have also been obtained when renewing the track by laying pre-assembled lengths on wood or reinforced concrete sleepers.

In general, such good results cannot be obtained when renewing with wood sleepers by the packing method or when laying concrete sleepers in the short intervals between trains owing to the constant interruption to the laying operations.

The appreciably shorter time taken to do the work (5 working days instead of 42) will enable the arrears in permanent way works to be made up, as in one year an incomparably larger portion of a main line can be renewed than with the old methods.

Another advantage of mechanised laying of reinforced concrete sleepers and long rails even on lines with heavy traffic is their probable long life and the considerable reduction in maintenance costs.

Whereas up to the present on lines of this exceptional class, it was necessary to count upon having to renew at the end of every 20 years and maintain the track by methodical overhaul every two years, with track laid on reinforced concrete sleepers with long welded rails without joints, it will probably only be necessary to renew the rails after about 35 years and the track after 60 to 80 years.

As the greater part of maintenance work is devoted to attention to the rail joints, considerable savings must be expected in the case of long rails. The work of the maintenance gangs will be limited to tightening up and correcting slight defects in alignment and level which must be corrected as soon as possible by means of light track machines. No information is as yet available on the life of beechwood corrugated bushes in concrete sleepers. It is certain that they will last at least 20 years. It is simple to replace them and does not upset the working in any way. Gangs equipped with trolleys will therefore be able to maintain appreciably longer sections of line. In all, the cost of maintaining the track and the resulting disturbance to the working should decrease by about 25 %.

One notable advantage of the momentary stopping of traffic on a line, by the organisation of single track working, is that it makes it possible to do other work which has been neglected up to the present, usually for operating reasons. The stopping of the traffic can be taken advantage of to do drainage work, improvements to the subsoil and to the line, to the insulation of bridges, repairs to the platforms and level crossings, if such work can be carried out at the same time as the renewal of the track. It is essential that they should be perfectly harmonised with the working programme.

The large machines can also be used very successfully to remake secondary lines, the maintenance of which has been greatly neglected, where the sleepers have to be replaced or renewed over the whole length of the line and where in many places the gravel ballast has become so consolidated that it has to be replaced by small stones, on condition the operating, traffic and traction departments take the necessary steps to close down the line for a few days.

By working on the line from either end, 10 to 12 km can be renewed in a week.

VI. Résumé.

The mechanisation of permanent way work has made enormous progress since the end of the war, and work is still in hand further to improve it.

The large machines and machines working one behind the other « in a chain » necessitate long working sites and working conditions uninterrupted by the train services.

The confidence and collaboration of the managerial departments of the operating and signalling are essential.

Industrialisation of permanent way work involves a precise and detailed preliminary study of all the operations involved and the respecting of the time laid down for the work.

The flexibility of the process is very great and can be adapted to all local conditions.

The technical results given by lines renewed by this method and welded in continuous lengths are excellent.

Considerable savings can be made in carrying out the work, above all in the maintenance of the track and rolling stock.

Mechanisation benefits both the permanent way and operating departments.

[656 .25 : 621 .33]

Signalling problems arising on lines electrified at industrial frequency,

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(From the review : « *Électricité* »).

I. Introduction.

Electrification is now the order of the day on railways in all parts of the world. It allows of the best use of our supplies of energy and permits countries which are poor in coal but possess abundant water power resources to cut down their imports: whilst in addition enabling railways to effect an appreciable reduction in their working expenses.

If electrification of itself offers these advantages, such will appear the more decisive as the cost of equipment becomes less. Electrification using current at industrial frequency, taking energy from the general supply network, is the type in which the cost of the fixed installations is the lowest. The sub-stations are reduced to the form of simple transformer stations while the high voltage used on the contact wires (to be 25 kV in future works) allows of the use of considerably lighter conductors, as well as the posts and standards carrying them and the corresponding foundations.

The problems arising in the construction of satisfactory traction motors generating on 50 cycle current have resulted in much important design and research work, the outcome of which has been described in the review *Electricité*.

The difficulties that had to be overcome in adapting satisfactorily the various fixed installations along the line to this type of electrification are, however, not so well known, but it is as well that they should be understood because on them depend the savings to be realised on the capital invested. as compared with other types of electrification. There are four classes of these installations, viz : the sub-stations, located from point to point along the line; the overhead lines transmitting the power coming from the sub-stations to the locomotives; the telecommunication circuits; and the signalling apparatus.

In the present case, we are concerned essentially with the last named. The problem consists in applying apparatus on lines electrified at industrial frequency fulfilling the same programme and meeting the same safety requirements as those called for on other lines, despite the presence of disturbing influences, and at minimum cost.

Let us, to begin with, notice very briefly what are the principal types of signal apparatus to be taken into consideration on railways of this kind.

First of all, it is necessary to ensure the protection of trains, following one another in the same direction. This is the *block* signalling problem and can be solved in two ways, either by using what is called the *manual block*, with signalmen stationed along the line to carry out the block signalling operations, or by applying the *automatic block*, in which the train itself, through electrical action and by its mere presence on the line, ensures its own protection.

In addition, on lines on which trains can run in either direction supplementary arrangements need to be made to prevent two trains from being sent head on towards each other (single line block).

Finally, at stations and junctions, *signal boxes* are provided from which the position of the points can be changed and the various routes set up, with all necessary guarantees of safety and of course the rapidity required by circumstances.

These particular safety installations use certain apparatus and circuits not liable to be affected by traction circuits at industrial frequency, such as the equipment situated inside the signal boxes, which do not differ in principle on electrified lines from those used elsewhere.

On the contrary, special measures have to be taken to ensure that two essential elements in such installations shall on no account be affected in any way. These are :

1) circuits formed by the two conductors in a cable (¹) which transmit along the line, either to the signal boxes or the signals themselves, those currents necessary to ensure their various safety functions being effected;

2) the track circuits, which form a vital element in the automatic block.

We will refer briefly to the principles of working of these arrangements and then state what has been done to construct equipment suitable for use on lines electrified at industrial frequency.

We may at once say that these new solutions to the problems involved have been tried on the Aix-les-Bains to La Roche-sur-Foron line. This section, electrified on single phase 50 cycle current, has served as a proving ground for apparatus intended to be used eventually on lines equipped in like manner. Thus the new automatic block arrangements were tested on this route although this type of signalling is not in actual service there, as the traffic does not justify it.

These trials were directed in the first place to investigating how the traction current was transmitted and how it acted in the rails and the neighbourhood of the track. Indeed, before endeavouring to find a means of dealing with disturbing influences it is necessary to record them and subject the results to an exact analysis.

We will begin therefore by explaining briefly how the traction current circulates and the effects it is liable to produce on neighbouring equipment.

The sub-station feeds the power to the contact line and establishes between it and the rails a high voltage difference (20 kV on the Aix-La Roche line, but 25 kV will be used in future work), at a frequency of 50 cycles.

The electric locomotive by means of its pantograph, running below the contact wire, picks up the current required to haul the train (100 amp. for example). The current reaching the locomotive in this way is called the *feed*, or *outward current*, the *return current* being that which goes back to the sub-station through the frame of the locomotive.

While the path of the former is quite clearly limited and defined this is not the case with the return current. It might be thought *at first* that this was carried throughout its course by the path provided by the rails; actually the circumstances are very different.

The insulation of the rails with respect to the ground has a relatively low value. In the case of direct current on a well-ballasted track the insulation per kilometre frequently falls to a mere few ohms, but when alternating current is used there is an appreciable amount of induction present, so much so that when the locomotive reaches a certain distance from the sub-station, the return current, for a great part of the way, flows through the ground, the rails only serving to carry it at the two extremities of the circuit, close to the sub-station on the one hand and to the locomotive on the other.

(¹) The case of underground, buried, cables alone is considered here, this being what is met with almost universally on lines electrified on single-phase current.

However, on the track in between, not then forming part of the return circuit, an alternating current displaced about 180 degrees from the return traction current, is met with, induced inductively by the loop formed by the contact wire and the ground.

It is necessary to keep this in mind in order to be able to understand the problems presented by track circuits on single-phase electrified lines.

In concluding these preliminary remarks, it has to be borne in mind also that lines electrified with this type of current induce in conductors parallel to them (overhead line wires or underground cables) longitudinal voltages the value of which is proportional to the intensity of the induced current and the distance during which the lines are parallel (these voltages are also proportional to the frequency of the current, as well as the coefficient of mutual inductance between the lines, and finally they depend too on the compensating effects brought about by currents circulating in neighbouring metallic masses.

The value and characteristics of the induced current will differ according to whether it is a question of circuits in cables on the one hand, and track circuits on the other.

In the case of conductors in lead covered armoured cables, trials have shown that the induced longitudinal voltage with cables in the position usually occupied by them, was about 0.05 V maximum per ampere in the contact wire per kilometre of parallelism of the conductors, for a current in the contact wire of about 100 amp. This value drops to about 0.3 V when the contact wire current reaches 500 amp., assuming this value to be the maximum needing to be considered in normal working.

From these considerations, it appears that the induced longitudinal voltage in a conductor will be about 15 volts per kilometre. (This is, be it noted, the voltage that would arise between one end of the conductor and earth, supposing the other end of it be itself earthed.)

In automatic block, the line circuits do not, as a rule, exceed 2 km (1 1/4 miles) in length. The induced voltage is therefore not dangerous to the staff nor to the equipment. In the case of manual block, the length of the line circuits can reach many kilometres when the block working is being carried on between stations a long way apart, in consequence of certain intermediate ones having been switched out. What has to be done then is to interrupt the corresponding line circuit in such a manner as to reduce each divided length to an amount which offers no danger from induced effects for staff or apparatus. The simplest course is to instal at carefully selected points relaying arrangements which create a break in the line circuit. (In this case, it is not possible, as it is with telecommunication circuits, to use transformers, since direct current is used in manual block workings.) Such relaying arrangements were used for the first time with standard block on the single track Aix-les-Bains to La Roche-sur-Foron line.

II. The single line manual block used between Aix-les-Bains and La Roche-sur-Foron.

On a single line no train must be allowed to leave a station A until the block section between it and station B is clear, and in addition, no movement has been authorised to take place from B towards A (see fig. 1).

The regulations ordinarily in force call for the exchange of messages between the stations A and B, one from A asking if the line is clear and the other from B confirming that this is so and accepting the train.

The manual block apparatus developed by the French National Railways and in service on the Aix-les-Bains and La Roche-sur-Foron line, eliminates this exchange of messages which require simultaneous action at the two stations, occupying a good deal of time, with a risk of misunderstanding.

When the station official at A wishes to clear his starting signal for a movement towards B, he « tests », as it is called, the circuit to that station which enables him to verify that the signals at B for the opposite direction of movement are correctly at danger and that « out of section » has been duly given to B for the last train which left that station for A.

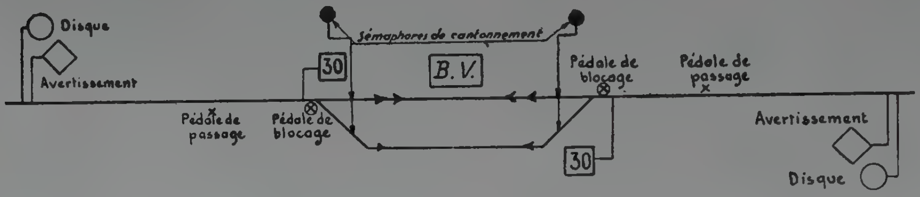

Fig. 1. — Standard signalling at single line station, with the direct line used for all non-crossing movements.

Explanation of French terms:
Disque = outer (deferred) stop signal. — Avertissement = distant signal. — Pédale de passage = releasing treadle. — Pédale de blocage = locking-up treadle. — Sémaphore de cantonnement = starting signal controlling entrance to block section.

FONCTION	1ère IMPULSION			2ème IMPULSION			3ème IMPULSION		
	Fil A	Fil B	Fil C	Fil A	Fil B	Fil C	Fil A	Fil B	Fil C
ANNONCE	+		−		+	−	−		+
TEST	−		+		−	+	+		−
RÉPONSE		+	−	+		−		−	+
REDDITION		−	+	−		+		+	−

Fig. 2. — Current used in operating the standard single line manual block.

Explanation of French terms:
Impulsion = impulse. — Annonce = train on line. — Réponse = acknowledgement. Reddition = out of section.

If these conditions are fulfilled the « test » operation operates, for a short interval at the station making it, an indicator called the « acknowledgement » indicator, and this allows the starting signal to be cleared provided always that « out of section » has been received from B for the last train sent towards that station.

Once the train in question has left A and replaced the starting signal to danger automatically (¹), A gives « train on line » for it, which is shown at both A and B by the appearance of appropriately coloured indicators.

As soon as the train has cleared the section A-B, station B sends « out of section » for it, this action being dependent on the

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(¹) At the same time as the starting signal goes to danger, the actuation of the « locking-up treadle » by the train locks the levers of that signal and this does not become free again until « Out of section » is received.

train actuating and passing clear of a treadle, proving that it has really arrived. (Indicators which change colour, notify the completion of this operation.) Each of these four block signalling operations (test, acknowledgement, train on line, out of section) necessitates the transmission between A and B of a current having particular characteristics. To prevent any false indications being produced, either by wires coming irregularly into contact, or induction from another circuit, the current used in each case is formed of three very short successive impulses of direct current, sent over three line wires. The table (fig. 2) shows the type and order of the various impulses transmitted over the line circuits and the wires used in each case.

In order to carry out these various operations and receive the indications he requires to effect the block signalling of the trains, the station official has a control panel illustrated in figure 3.

This comprises for each direction a « test », a « train on line », and an « out of section » button, an « acknowledgement », a « train on line » and an « out of section » indicator.

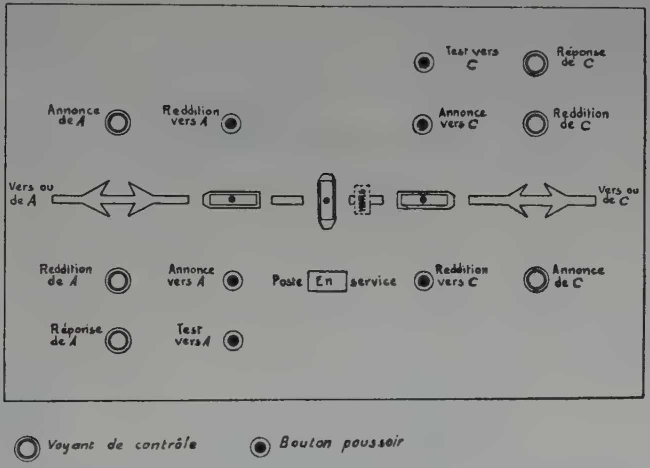


Fig. 3. — Standard single line block apparatus Control and proving panel used by station official.

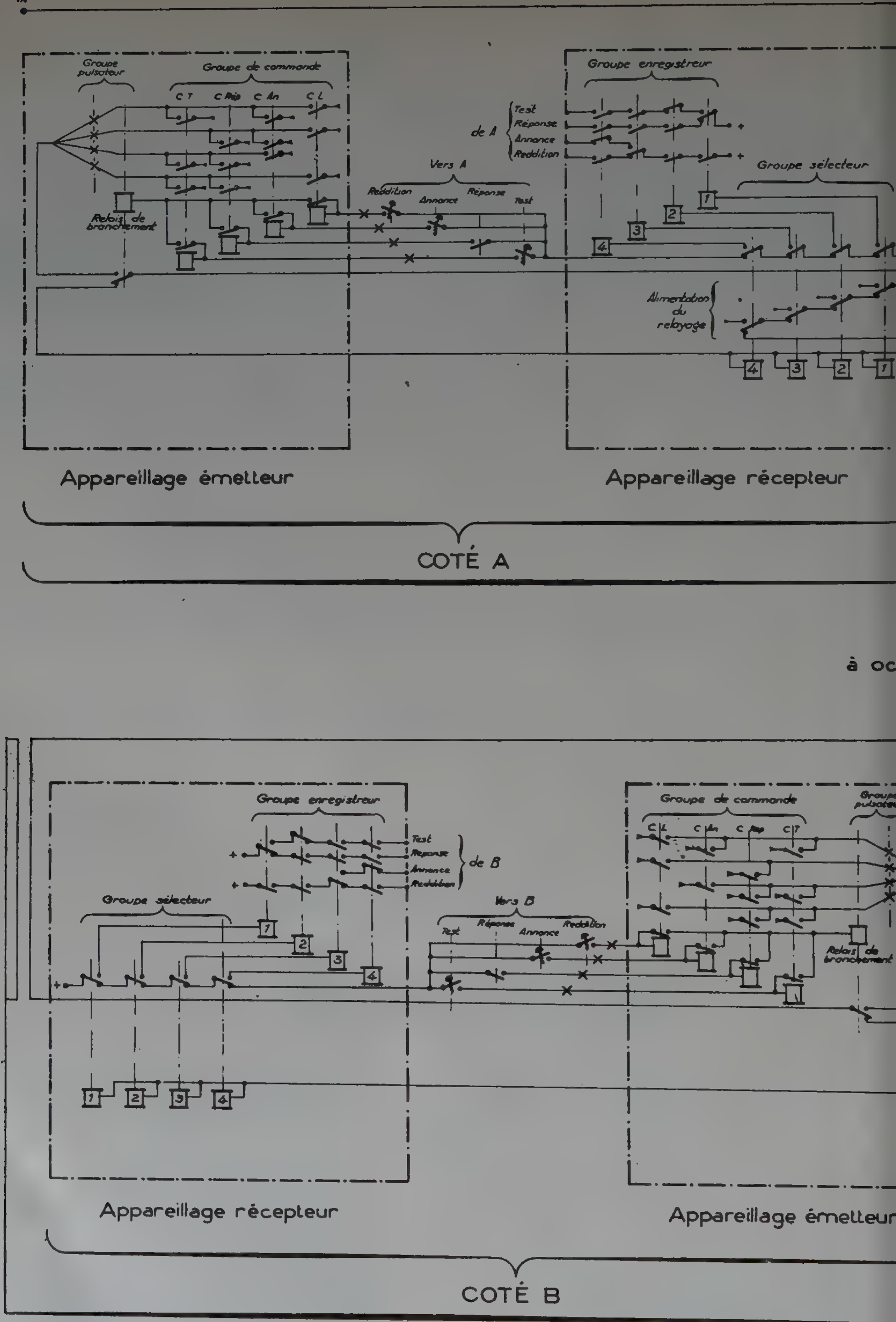
Explanation of French terms:

Réponse de = acknowledgement from. — Annonce de = train on line from. — Reddition vers = out of section to. — Vers ou de = to *and* from. — Annonce vers = train on line to. — Reddition de = out of section from.

This system readily allows of an intermediate station being switched out by the simple manipulation of a circuit changer (fig. 3), which allows of economies in the use of staff. However, when several such stations are closed simultaneously, the length of circuit connecting the end stations becomes excessive by reason of the voltages that risk being created in it. To prevent this length in no case exceeding that between two stations (whether open or closed) an arrangement has been devised for repeating the impulses. (This is necessary only on single-phase electrified lines).

The simplified diagram given in figure 4 shows the principle of working of the standard single line block.

At the upper part appears the equipment at station B, which closes at intervals (a change-over switch allows this to be effected). For convenience of reproduction here the equipment at station A (on the side

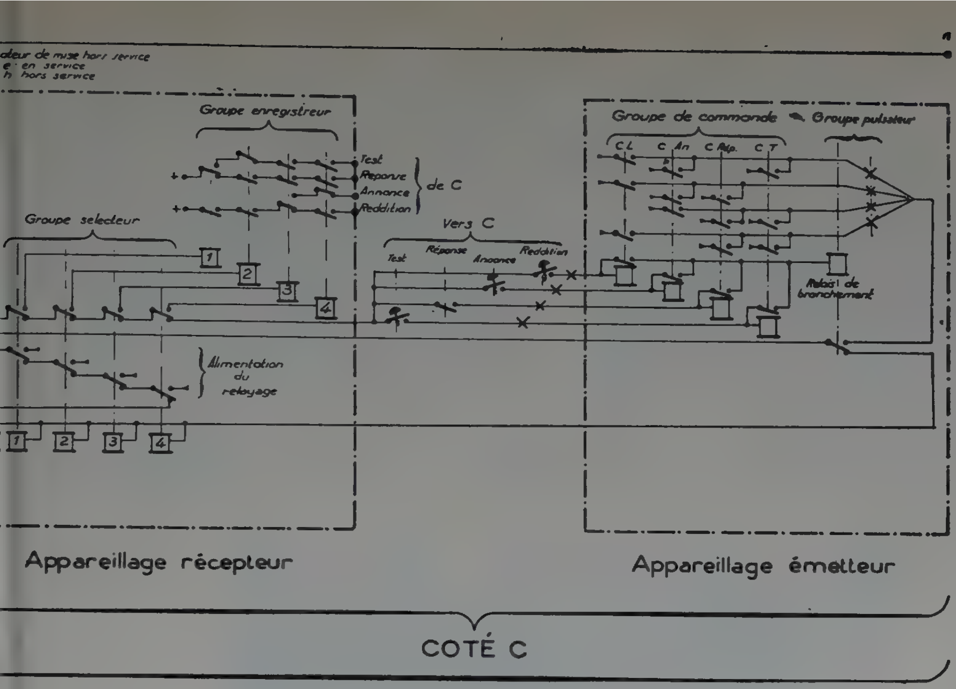


GARE A
à occupation permanente.

Fig. 4. — Simplified diagr

Exp

Gare A (C) à occupation permanente = station A (C) always open. — Côté = side towards. —
= impulsing group. — Relais de branchement = line circuit selector relay. — Groupe enreg
supply to relays. — De = from. — Vers = to. — Test = test. — Réponse = acknowled
switch. — *e* - en service = station open. — *h* - hors service = station closed.



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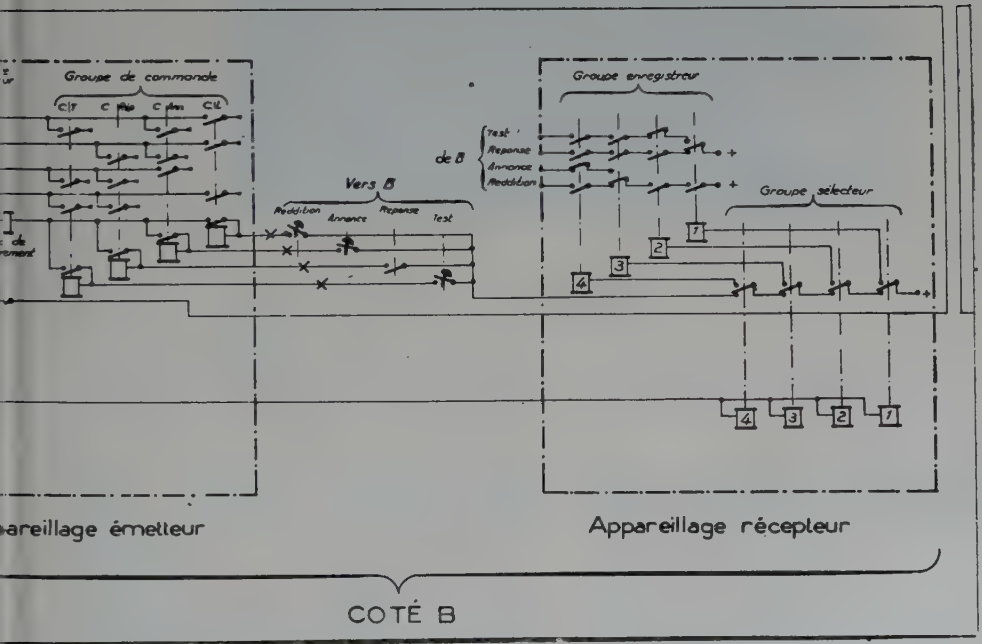

nual block apparatus.

GARE C
à occupation permanente.

ms :

= transmitting assembly. — Appareillage récepteur = receiving assembly. — Groupe pulsateur ecording group. — Groupe sélecteur = selecting group. — Alimentation du relayage = power train on line. — Reddition = out of section. — Commutateur de mise hors service = closing

towards B) and that at C (on the side towards B) have been placed below the part showing the apparatus at B itself. At both stations A and C, there are a transmitting set of relays, etc., and a receiving set, indicated diagramatically. (These comprise a line circuit selector relay, an impulsing set, a controlling set, controlling the sending of the « test » impulses, also « train on line » and « out of section », all applying to the complete transmitting unit; also a storing set, a selecting set and the receiving relays at which the incoming impulses arrive all for the receiving unit.) The equipment at station B is in communication with that at stations A and C.

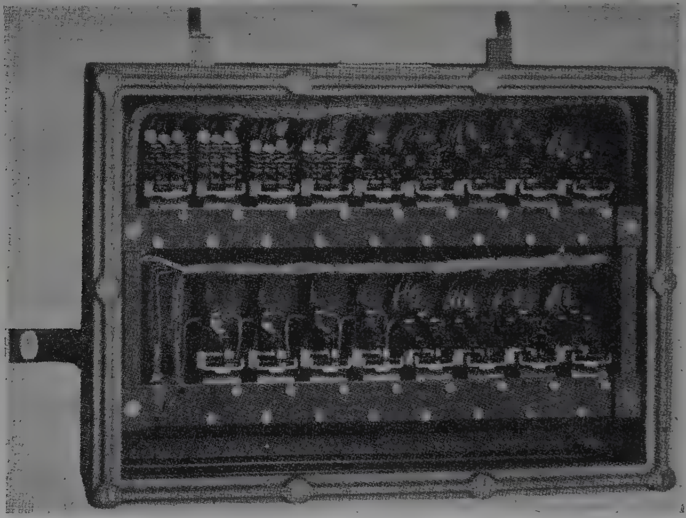

Fig. 5. — Transmitting and receiving assembly used with the manual block.

Whether station B is open or not relays 1, 2, 3, 4 interrupt the line circuit at that point, thus limiting the length of circuit exposed to the longitudinal induced voltage.

Fig. 5 is a photograph of a complete transmitting and receiving assembly, in which can be seen the small relays used for this purpose. These assemblies have jack-in or plug connections, enabling them to be readily changed for periodical inspection, or in case of a fault developing.

III. Different arrangements used for automatic block on lines electrified on 50 cycle current.

On non-electrified lines, the simplest and most frequently used arrangement is to instal track circuits fed by direct current. The track relays short circuited by the axles of the train effect its protection automatically, as it passes along, by producing the required block signal indications, namely « stop » preceded by a « caution » or « approach » indication (fig. 6). We limit ourselves here to the simplest case, that of the 3-aspect block (1).

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(1) It is to be noted that on non-electrified lines nothing prevents both rails of the track from being provided with insulated joints, although in certain countries, for reasons of economy, it is thought sufficient to put them in one rail only.

An improvement on this arrangement consists in using track circuits with polarised relays with two windings, one fed from a local source of supply, the other connected to the track. The relay is energised to close its contacts only when the current coming from the track passes through it in a certain direction. This protects the relay against any irregular energisation, more particularly when the insulating joints become defective. (The polarity of the feed is regularly reversed, or staggered, from one section to the next throughout the line.) (See fig. 7.)

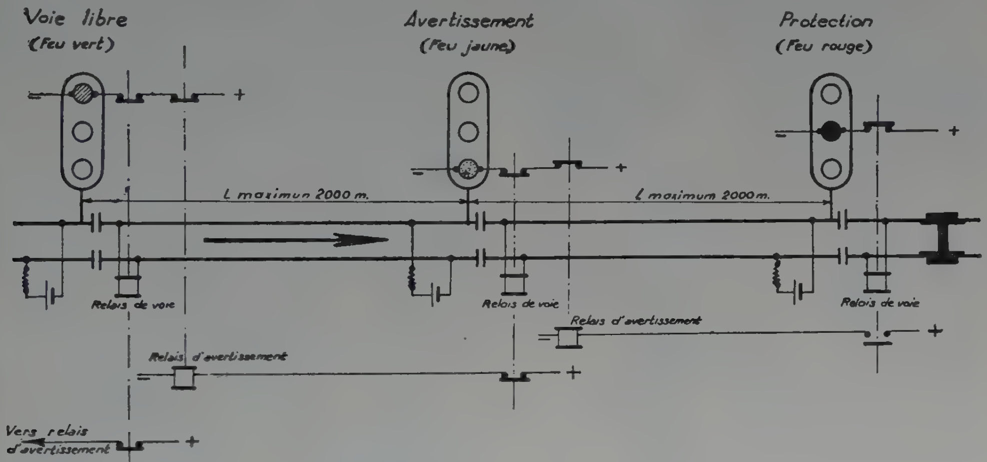


Fig. 6. — Line equipped with automatic colour-light signalling.

Explanation of French terms:

Voie libre (feu vert) = clear (green light). — Avertissement (feu jaune) = caution (yellow light). Protection (feu rouge) = stop (red light). — Relais de voie = track circuit. — Relais d'avertissement = caution aspect control relay.

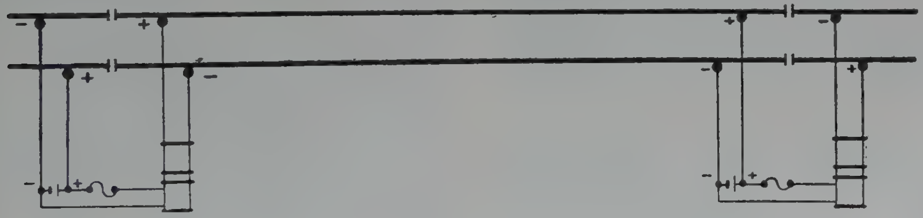
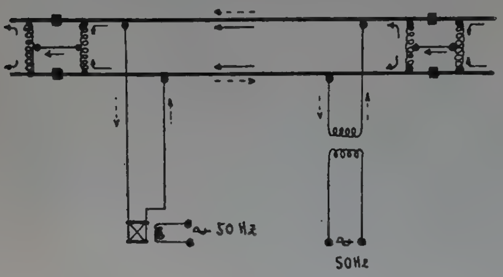


Fig. 7. — Polarised track circuit for non-electrified line.

On direct current electrified lines, the track circuits must allow of the return current passing the whole length of the line towards the sub-station and along each track circuit the signalling current must be free to pass. For track circuits over a certain length the solution consists in installing at each end an inductive connection formed of a copper bar of large cross section wound on a magnetic circuit made up of iron laminations. A few turns are enough to make such a connection offer to the 50 cycle signalling current a high impedance (see fig. 8). This inductive connection is provided with a centre point connected to that on the one applying to the adjoining section. The resistance of the two rails of each half of the circuit must be approximately the same, so that the current in the two branches of the inductive connection shall be for practical purposes equal. (The ordinary fishplates are connected across by welded copper connections which present a very low resistance to the current.)

The track relays have both a local and a track winding. The phase displacement between the two is such that it brings about the movement of the relay armature, but if it is in the opposite direction it has no effect on the relay. By reversing the phases as between one circuit and the next, a relay is protected against becoming irregularly energised by current from an adjacent section.



◄——— Traction current.

◄- - - - Signalling current.

Fig. 8. — Diagram showing principle of track circuit for D. C. electrified line.

Hz = cycle.

It is possible also in the case of short track circuits to dispense with the inductive connections; one rail then serves for the traction return current, the other alone being provided with insulating joints. A limit is set to this arrangement as regards length of circuit by the difference of potential created in the rails by the return traction current.

On lines electrified at 50 cycles several arrangements may be used for feeding power to track circuits.

The first consists in using, with certain modifications, the direct current arrangement, which obviously has to be abandoned in the case of a line electrified with the same kind of current. This is particularly simple and economical and the inverse of the preceding arrangement. One of the rails is allocated to the return 50 cycle current while the other is provided with insulating joints at each end and carries the signalling direct current. The track relay has two windings, one serving to polarise it as already described in the case of non-electrified lines (see fig. 9). The characteristics of the track relays must be very carefully determined so that the maximum voltage likely to arise when a train passes will not be able to have any effect on them. For track circuits over a certain length, it is no longer possible to use the well-known type of relay with a 4 ohm winding. In practice, a 40 ohm relay is used with a fixed 40 ohm resistance shunted across the terminals connected to the track. An impedance and an adjustable resistance are connected in series with the relay and a similar arrangement is used at the feed end of the circuit.

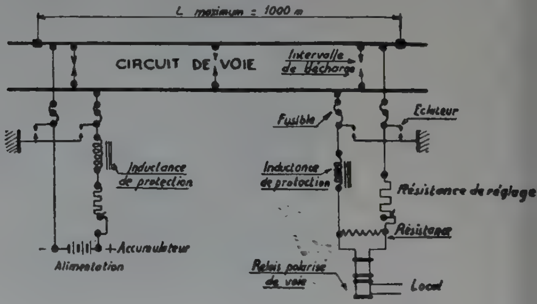


Fig. 9. — Direct current track circuit for line electrified at industrial frequency.

Explanation of French terms:

Circuit de voie = track circuit. — Intervalle de décharge = discharge gap. — Inductance de protection = shielding impedance. — Accumulateur = secondary battery. — Alimentation = feed. — Fusible = fuse. — Eclateur = over voltage discharge gap. — Résistance de réglage = adjustable resistance. — Résistance = resistance. — Relais polarisé de voie = polarised track relay. — Local = local winding.

While the direct current feed affords a simple and economical solution, it is acceptable only where there is no stray direct current in the neighbourhood liable to make use of the return rail and irregularly energise the track relays. Therefore near direct current electrified lines, or in the neighbourhood of towns with tramway systems, or of mining or industrial undertakings using direct current and earth return, it is often found, in a continuous railway rail, that a direct current is flowing which makes it impossible to use direct current track circuits of over about 100 m (328′ 1″) long. It is necessary then to have recourse to some other form of current. (The maximum length of the sections in automatic block and consequently of the track circuits is 2 km = 1.24 miles.)

Track circuits operating at 50 cycles being well known and brought to a state of full development, it proved of interest to find a frequency sufficiently distinct from 50 cycles to render the track relays unresponsive to that figure, but also sufficiently close to it to allow of using equipment as nearly like that already in service as possible. These conditions have led to the adoption of a frequency of 83 1/3. This offers the advantage of being easily produced. It is possible to do this with the aid of a generating set consisting of a synchronised asynchronous motor revolving at 1 000 r.p.m. and driving a synchronous generator having two pairs of poles. The motor revolves in the opposite direction to the rotating field set up by the generator for field windings itself revolving at 1 500 r.p.m. The frequency of the current collected from the armature is the same as that of an alternator revolving at 2 500 r.p.m. which is :—

$$\frac{2\,500 \times 2}{60} = 83\ 1/3 \text{ Hz.}$$

Moreover, in designing relays to work at this frequency, the improvements made of recent years in the construction of 50 cycle relays can be taken advantage of, and the results obtained have allowed of installations being constructed without the least difficulty giving very regular working in service. The shunt limit of these track circuits, or what amounts to the same thing, the sensitiveness of the track relays to de-energisation by train axles offering some resistance, is greater than with 50 cycle relays.

The general arrangement of the track circuit shown in figure 10 is very similar to that given in figure 8 for direct current electrified lines. The inductive connections (known as impedance bonds) transmit the 50 cycle traction current but oppose the passage of 83 1/3 cycle signalling current. Even should a high voltage at 50 cycles become applied to the track relay it would not become irregularly energised. (It is to be noted that if it is not so convenient to have a 2-phase 83 1/3 cycles supply instead of a 3-phase 50 cycles one, the inductive connection becomes much smaller and cheaper than would be required with direct current traction, the currents met with being very much smaller.)

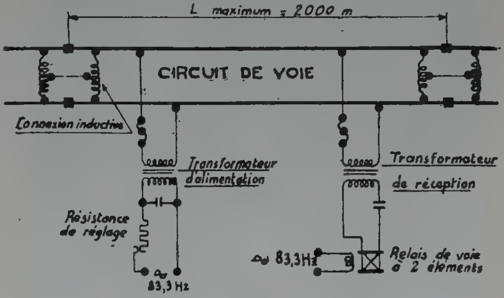


Fig. 10. — Track circuit working at 83 1/3 cycles for line electrified at industrial frequency.

Explanation of French terms:

Circuit de voie = track circuit. — Connexion inductive = inductive connection (impedance bond). — Transformateur d'alimentation = track feed transformer. — Transformateur de réception = relay transformer. — Hz = cycle. — Relais de voie à deux éléments = 2-element track relay. — Résistance de réglage = adjustable resistance.

As in the case of direct current electrified lines, it is possible to have track circuits without inductive connections, for short lengths, fed at 83 1/3 cycles. The limiting factor is the amount of 50 cycle current passing through the relay and which without causing it to become energised irregularly, is yet liable to set up vibrations of the armature susceptible of causing damage.

It should be observed that the double rail type of track circuits (fig. 8 and 10) possess the feature that the stop signal will become exhibited should one of the rails become interrupted, particularly in the case of a breakage. (It is necessary however — and this in fact rarely occurs — that the two portions of rail shall become so effectively separated from each other as to prevent the signalling current from flowing). This automatic detection of a broken rail is not always effected when the track circuit has one rail not insulated and the breakage occurs in that one, as the current can pass round through the earth independently of the rail. As, however, a rail breakage more often results in no actual piece coming away but leaves the signalling circuit uninterrupted this advantage of being able to detect such a fault automatically is somewhat reduced. Moreover, it is the track inspection which ought to find such breakages and this is carried out independently of the automatic block. It has perforce to be relied upon on those lines — the most numerous — on which such signalling does not exist. This is why, in various countries using single-phase electrification and track circuiting, the single rail type of circuit is the one most often used and a long experience has proved that this is the correct course to take, at least in the case of lines of ordinary type and where to do so offers economic advantages. (This arrangement is however at times completed on double lines by providing connections between the return rails at sufficiently close intervals. This is not done to obtain automatic detection of a broken rail, but to ensure the de-energisation of the relay on the passage of the train throughout the length of the track circuit in the very exceptional case of two complete breaks occurring in the section. The probability of such breaks taking place all in the return rail between two successive cross connections may be regarded as negligible on the majority of railways.)

Another precaution needs to be taken with track circuits on electrified lines, at least when they are over a certain length, it is possible for the traction contact wire to break and fall on the rail. The circuit breaker in the feed at the sub-station should then operate to cut off the supply to the wire. Should the energised wire fall on the insulated track circuit rail a full and complete short circuit will not be produced; moreover the track circuit equipment would risk becoming damaged. Finally, should a lineman be working on it at the time he would risk being exposed to a dangerous voltage. For this reason, it has been considered necessary to instal a device to provide a path for the short circuit current without interfering at ordinary times with the operation of the track relay. This condition is fulfilled by a kind of spark gap, specially constructed for this purpose and connected between the insulated rail and the return rail of the track circuit. This device is called the « high voltage discharge gap ». It breaks down at a certain adjustable voltage (from 100 volts for example) and allows the short circuit current to be led away.

The break-down or striking voltage has to be calculated with regard to the differences of potential liable to be produced at the terminals of the apparatus in normal circumstances, i.e. when the contact wire or the return circuit are carrying the maximum current met with in regular working. To arrive at these it is first necessary to consider what is the current induced in the insulated rail, with the track unoccupied and an appreciable current flowing in the contact wire. The inducing circuit is the loop formed by that wire and the return circuit.

It is also necessary to take into account the fact that to this induced current the return current making use of the non-insulated rail requires to be added in certain circumstances. (This occurs when a locomotive is a short distance beyond the track circuit with respect to the sub-station while others are taking current at a greater distance.)

Systematic tests have been carried out on the Aix-Annecy section and have confirmed both the efficiency of and necessity for the « high voltage discharge gaps ». They shew that with track circuits limited to 1 000 m (1 033 yards) (a condition applicable only to single rail track circuits) the setting of the gaps can be fixed at 150 volts, taking into account the most unfavourable circumstances.

So far, we have dealt with either direct current or 83 1/3 cycle current as feed supply for track circuits on lines electrified at 50 cycles. While the frequency of 83 1/3 offers undeniable advantages from the point of view of convenience, it is possible to use others differing sufficiently from 50. From the moment when industrial frequency is exceeded, however, it becomes attractive to come within the range of musical frequencies, allowing of the use of apparatus developed for radio-telephony and sound reproduction.

Trials are in hand with equipment of this kind but prolonged experience with it will be required before it can be known with certainty that it meets fully the numerous and complex conditions which track circuits are required to fulfill. In addition, an actual working installation alone can show what the cost of such equipment would amount to and what the economic advantages or otherwise associated with it would be.

To complete the picture, it is necessary to refer to the coded or pulsating current track circuits which offer a solution of some value to the problem now concerning us. However, the apparatus required, particularly the impulsing relay, gives rise to rather high first cost and maintenance charges. For this reason, although this solution is of great interest in certain circumstances, it is not capable of competing with earlier arrangements when long routes are in question.

IV. Conclusion.

This brief examination of a few new signalling problems raised by railway electrification at industrial frequency sets out the solutions adopted so far, as well as those under trial or being investigated.

In any case, these solutions are clearly in line with those complete installations of which a large use already has been made on non-electrified lines, or those electrified on direct current. The safety conditions complied with in particular are the same in either case.

However, as explained above, the manual and automatic block equipment entail costs of the same order — in certain cases of direct current apparatus somewhat less — as those incurred on direct current electrified lines. The results of this investigation are to be turned to account in equipping the North-Eastern main line, Valenciennes-Thionville, the electrification of which at industrial frequency is in hand.

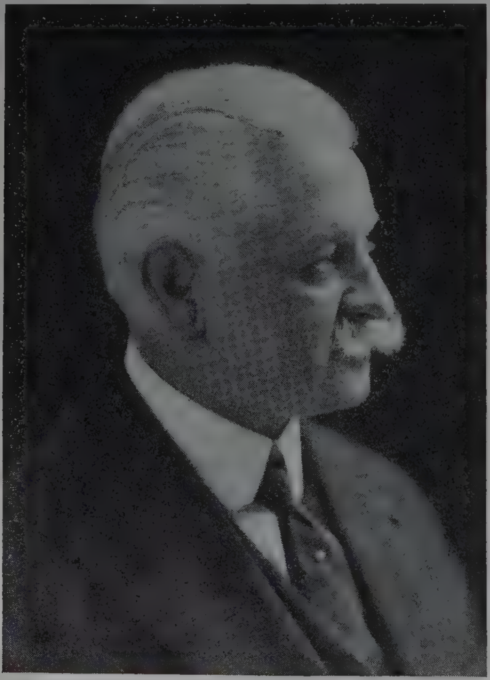
This conclusion is worth noting although the great savings made possible by electrifying in this manner do not apply to signalling but the high tension distribution system, the sub-stations and contact wire equipment.

[385. (09 .2]

OBITUARY.

Maurice MARGOT,

Directeur Général Honoraire de la Compagnie des Chemins de fer de Paris à Lyon et à la Méditerranée.
Grand Officier de la Légion d'Honneur.
Former Member of the Permanent Commission of the International Railway Congress Association.



We have learnt with regret of the death in Paris on the 30th January 1954, of M. Maurice Margot, Honorary General Manager of the P. L. M. Railway.

M. Margot was one of the last general managers of the former French Railways Companies amalgamated in 1938, into the present S. N. C. F. For fourteen years, from 1919 to 1933, he was in charge of the largest of them, commonly known as the P. L. M.

The 10 000 km (6 200 miles) of the P. L. M. cover one quarter of the national railway system and serve the whole of the South-East of France, and the three largest cities in the country : Paris, Marseilles and Lyons, and the universally celebrated countryside of the Alps and Cote d'Azur. Owing to its position, it commanded important relations between the western world and Switzerland, Italy, the countries beyond them, and the East. It even overflowed onto the African side of the Mediterranean, where the P. L. M. Company operated more than a quarter of the Algerian railways.

This will give some idea of the importance of the functions of a manager of such an organisation and the very special qualities it required.

These qualities M. Margot had in abundance.

A brilliant scholastic career led him in 1883, then barely 19 years old, to the Polytechnique which he left in the « Corps des Ponts et Chaussées ». In 1893, he entered the service of the P. L. M. as a permanent way engineer; he was soon transferred to the Operating Department where he became chief engineer in 1907. His successful handling of these important duties, especially during the transport difficulties of the war, led the P. L. M. at the beginning of 1918 to make M. Margot, Operating Manager in charge of the three great Departments : Operating, Rolling Stock and Traction, and Permanent Way. At the same time in this year 1918, the French Government at grips with the multiple transport problems raised by the advance of the Allies, made sure of getting the direct assistance of M. MARGOT by appointing him manager, under the Minister of Public Works and Transport, of the Central Railway Operating Department.

This magnificent career was finally crowned on the 5th May 1919, by his appointment as General Manager of the P. L. M. Company.

M. MARGOT, in these duties, the importance of which has already been made clear, displayed until his retirement in 1933, immense activity in every field, first of all rapidly restoring his railway from the effects of the war, then fitting it out with up to date and powerful equipment, both as regards the fixed installations and the traction and rolling stock.

Parallel with the considerable programme thus carried out in the technical field, M. MARGOT completed an equally vast one in the commercial field, successfully undertaking everything likely to increase traffic and develop the agricultural and industrial activity of the districts served by the P. L. M. Amongst these multiple achievements in this field, we cannot pass over the setting up of the South East Transport Office and the impulse given to tourist propaganda, the introduction of the « Route des Alpes » being one of his most brilliant successes.

An incomparable planner and achiever was M. MARGOT, not only in technical and commercial matters, but also, and to a still more striking degree, in social affairs. He perfected, and often created, and followed with close personal attention, all sorts of institutions of this kind. His generous temperament, together with his convictions, naturally inclined him towards an interest in the employees of the railway, many of whom were personally known to him, thanks to the endless visits he made to all parts of his system.

A great traveller over the lines of the P. L. M., M. MARGOT also liked to travel beyond it and over the whole of Europe, particularly on the occasion of international reunions of railway managers, whether it was a question of general problems debated by the International Railway Union and the International Railway Congress Association, or conferences dealing with inter-state railway relations, such as the organisation and development of the train known as the « Simplon-Orient Express » which was to a great extent due to him.

M. MARGOT was elected a member of the Permanent Commission of the International Railway Congress Association at the Plenary Session of the 28th April 1922 of the Rome Congress. He took part in the London Session in 1925 and the Cairo Congress in 1933 where he presided over the Third Section (Operating), which dealt amongst other things with the important question of automatic train control. In spite of his many duties, M. MARGOT always showed a great interest in the work of our Association and his former colleagues on the Permanent Commission will always remember him.

In these international meetings, he took a leading part on account of his great competence, his courteous behaviour and the great charm of his personality. For this reason, he represented on a great many occasions, on many and important bodies, either his own Railway Company or the French Railways as a whole : this was the case for example on the Administrative Council of the German Railways set up after the 1914-1918 war.

He also participated in the creation of

the Morocco Railways and was president of the Moroccan Oriental Company.

The French Government bestowed on him the honour of Chief Officer of the Legion of Honour, and he held a great many foreign decorations.

M. MARGOT was a striking personality not only of the French Railways, but of the railway world as a whole. His great qualities of heart and mind were as much appreciated as his work, and his death has caused unanimous regret.

We pay a tribute to his memory and present our heartfelt sympathy to his family.

The Executive Committee.

NEW BOOKS AND PUBLICATIONS.

[**656** .28 (42)]

Lt. Col. G.R.S. WILSON, C.B.E., Chief Inspecting Officer of Railways, Ministry of Transport and Civil Aviation. — **Report to the Minister of Transport and Civil Aviation upon the Accidents which occurred on the Railways of Great Britain during the year 1952.** — One brochure (6 × 9 ½ in.) of 66 pages. — 1953, Her Majesty's Stationery Office, York House, Kingsway, London, W.C. 2 and 423, Oxford Street, London, W. 1. (Price : 2 s. net.)

As in the previous reports, the accidents are grouped into three categories : train accidents, traffic accidents and accidents which had nothing to do with the traffic. Again the accidents are divided as follows : *a*) to passengers; *b*) to railway employees, and *c*) to other persons.

General statistics as well as other more detailed statistics are given in the report and in the appendices. They are set out in such a way as to make it possible to compare the last three years and the averages for previous years.

The number of train accidents was lower than in 1951. But unfortunately one serious accident, a double collision at Harrow, increased the number of victims. Again, the collapse of a footbridge increased the number of persons injured.

Statistics are kept of the number of train accidents which gave rise to an official enquiry by Departmental Officials. There were 14 such in 1952. In each case, the report gives a brief analysis of the circumstances and measures which could have been taken.

Damage occurring in transit is decreasing, especially that due to broken couplings which are the chief cause. Damage to rolling stock and rail breakages have also decreased. The number of wagons equipped with automatic brakes for special services has slightly increased and the question of fitting all goods trains with automatic brakes is under consideration.

Accidents at level crossings remain fairly numerous, especially at those where there are no keepers. This question continues to receive the attention of the operators and of the Authorities.

Most of the victims of traffic accidents were railway employees. The best method of arming them against such risks is proper training and the report recalls the programme introduced by the Executive Committee.

Failure to obey the signals caused about the same number of accidents as in the previous year. Some of these could have been prevented by the use of an automatic train warning device. The Transport Commission has decided to put in hand a programme for the extension of this measure as soon as the system now being tried out on a large scale has proved its worth.

Not a single point affecting safety is left untouched. The conditions of repair of the traction and rolling stock, the modernisation of the latter, the maintenance of the permanent way, the modernisation of the signalling are all gone into with appropriate commentaries.

In his conclusions, the author again stresses the importance of the part played by the staff and that of automatic train control.

E. M.

[**656** (4)]

Europa-Verkehr (European Transport Annual), 1953. — One brochure (8 × 11 3/4 in.) of 132 pages, copiously illustrated, — 1953. Otto Elsner, Verlagsgesellschaft, Darmstadt, Holzhofallee, 35 (Price per brochure, 6 D.M. — Yearly subscription (4 brochures) : 20 D.M.).

The editorial note to this new issue clearly defines the guiding principle on which it is based. Whilst stressing the preeminent role of transport in the economy of the peoples, this is to show its activities in the international field. The inaugurators of this review look upon transport as the true and most effective pioneer in the integration of Europe. The studies included are centred on the same idea, the European aspect of the technique of transport.

In fact, the 16 articles included in this unique issue of 1953 all deal with questions of international communications and transports. This is seen in the case of a study on the French Project for the Rhone, which evokes the idea of the Rhine-Rhone link-up. Another, that dealing with the lightening of rolling stock on both railway and road, though not so marked in character, is also of general interest.

The majority of the authors write in German; only two articles are written in French (with a brief translation into German). Is it to be inferred that the European idea has gained the most ground in Germany?

All methods of transport are dealt with in this volume: railway, road, inland waterways, aviation, transmission of current. In the chapter dealing with communications, mention must be made of a note on telephony, including radio-telephony, a fertile field for developments as regards the difficulties and the needs of international relations.

In the purely railway field, there is a note giving the history and describing the activities of the European Conference on Timetables, and another on the position and future of the railways of Europe. The latter, in view of the benefits obtained through the setting up of such organisations as are included in the I. R. U. (U. I. C.), but with certain reservations as regards better coordination, favour the efforts made to set up a European Transport Office or Council.

E. M.

[**656** .285]

BUREAU INTERNATIONAL DU TRAVAIL. — **Causes des accidents survenant lors de l'attelage des wagons de chemins de fer et des opérations connexes et mesures de prévention.** *(Accidents occurring in coupling up railway wagons and similar operations, and the methods of preventing them.)* One brochure (8 × 11 in.) of 24 pages, illustrated. — 1953, Geneva, International Office of Work. (Price : 1 Swiss fr.).

The *International Office of Work,* now an integral part and one of the chief components of the International Organisation of Work, has carried out an enquiry into accidents which occur on railways when coupling and uncoupling the stock. The investigations were carried out in order to give effect to a resolution of the Sub-committee of railway transport on the European Economic Commission (set up by the United Nations). The report was to be presented in January 1954 at the session of the Committee of Internal Transport of the European Economic Commission.

The enquiry only covered three countries selected by reason of the nature and size of their railway systems : France, Italy and Switzerland. Information was collected on site and from officials and employees of various grades. The report mentions that it was apparent from the beginning that very real efforts has been made by the railway managements concerned to increase safety.

As a basis for their study, the authors collected accident statistics. They classified these under various headings in a table giving five categories. Each of these is studied separately. This led the investigators to examine, according to the extent to which they give rise to danger of accident, the fixed installations, working methods, and certain arrangements of the rolling stock. A special chapter groups together the statements made concerning the administrative organisation, the professional guidance and the training of the staff.

In their general conclusions, the reporters give a dozen recommendations which seem to them particularly likely to lead to a further reduction in the number of accidents to certain categories of railway employees.

E. M.

[385]

JOUFFROY, (L.M.), **L'Ere du Rail.** *(The Railway Era.)* Preface by Raoul DAUTRY. — Armand Colin Collection, History and Economic Science Section. — One volume ($4\,^3/_8 \times 6\,^1/_2$ inches) of 224 pages with maps and illustrations. — 1953, Paris, Librairie Armand Colin, 103, Boulevard Saint-Michel (Price : 250 French francs).

Under this title, the author has written a history of the railway from its earliest beginnings to the present day. Born at the beginning of the last century, the railway has had such a profound effect upon the life of the people that it is legitimate to speak of it as a new era. A perusal of this book moreover will show how much greater progress has been achieved during this stage than in any previous century.

Wishing to depict the world which the railway was to revolutionize in such a way, the author goes into the idea of terrestial space as characterised by its accessibility. The table giving the *Space factor in the time of carriages* shows very clearly how the most progressive peoples suffered from the poorness of methods of communication one hundred years ago.

In the second part of the book, the *Conquest of space,* the *Birth and development of the railway* is described first of all, then the *Empire of the railway,* the perfecting of this method of transport, administrative transformation, commercial organisation, and the technical revolution.

The study covers not only France but the chief countries of Europe and the United States of America.

In the third part, the *Transformation of space,* the first chapter, *Space in the days of steam,* shows how the railway has revolutionized the world. In the other, *Towards a new space,* new methods of transport come into the picture, and affect the railway in various ways. The author shows the complexity and importance of the questions raised by the multiplicity of interests involved and the structure of the present day world. The *Resistance of the Railway* is shown by the concentration of its activities, the common user of its resources, standardisation in all sections, speeding up the traffic, ferry-boats, rail-road combinations. This chapter ends with considerations on the future evolution of the railway and of transport in general.

In his conclusion, the author gives his opinions regarding the influence of the diffusion and individual characteristics of transport at the present time upon civilisation.

E. M.

[385 (061 (7 + 8)]

Asociación del Congreso Panamericano de Ferrocarriles. VIII Congreso (Washington, 12-25 de Junio de 1953). *(Panamerican Railway Congress. Report of the VIIIth Congress. — Washington, June* 12-25, 1953.*)* One volume (7 × 9½ inches) of 260 pages, illustrated. — 1953, Buenos Aires, *Boletín de la Comisión Permanente de la Asociación del Congreso Panamericano de Ferrocariles*, July-September, Calle Perû, No. 277.

The idea of holding Railway Congresses in South America dates back to 1907 when the Argentine Republic was preparing to celebrate the centenary of its independence. Founded in 1910 at Buenos Aires, the Association has never ceased to extent its activities, and the participation of the great railways of the U.S.A. and Mexico justifies its present name of Panamerican Congress. Another significant point was the choice of Washington for the VIIIth Session.

This session took place under the most favourable auspices. The highest authorities of the great American Republic lent it their enthusiastic support.

This volume gives a brief account of the work of the Congress and the ceremonies which took place.

The text of the speeches made at the solemn opening meeting are given, in particular those of Mr. Richard M. NIXON, Vice-President of the U. S. A., together with the agenda for the Congress, the list of delegates of the organisations taking part and the various special delegations.

The number of reports sent in amounted to 168. These were examined first of all by « reporter » members, responsible for bringing them to the notice of the appropriate section. The review of the plenary meetings shows the reception received by the proposals of the sections.

The complete list of studies shows the decisions taken as regards the publication and the honorary rewards bestowed. Besides these were a certain number of monetary rewards awarded on the recommendation of the special committee to particularly noteworthy achievements.

The question of the publication of the work of the Congress was the subject of discussion intended to increase its efficiency without excessive expenditure.

Amongst the many other subjects examined was the composition of the local committees which exist in most of the member countries, and their activities. These local committees, which have representatives sitting on the Permanent Commission, are responsible for following in their respective countries the evolution of questions in which the Congress is interested, and they play an active part in the preparation of the programme for future meetings.

The Congress Delegates were received at Atlantic City where they visited a huge exhibition of railway stock. Amongst the installations which they were privileged to see may be mentioned that for loading iron and coal on the Baltimore and Ohio Railroad, and the Potomac marshalling yard, one of the largest and most up-to-date in the whole world.

The reports and memoires are published separately and can be obtained on application to the Permanent Commission at Buenos Aires. A complete collection was very kindly sent to us, and has been put in our Secretariat.

A perusal of this volume gives the impression that this VIIIth Panamerican Congress was the huge success it was hoped for.

The next session, according to the decisions taken at Washington, will be held in 1956 at Buenos Aires.

E. M.

[**385** (02]

Railway Materials Handbook. — One volume (6 × 9 inches) of 372 pages, illustrated. 1953, Sheffield. Published by the United Steel Companies (Price : One Guinea).

The « United Steel Companies » in Sheffield run four of the main steel foundries of the country. They manufacture more than two million tons of steel a year, one eighth of the total production of the whole country. A large part of this tonnage consists of railway materials, either as a raw material or the finished product.

This handbook is intended to advise railway engineers and store keepers of the manufactures of the various departments of the United Steel Companies and specially of those amongst them whose products are mainly used by railway engineers.

Amongst the products manufactured by this firm are rolling stock components : wheels, tyres, axles both straight and bent, springs, spring buckles, piston rods. Amongst permanent way components are rails, fishplates, bearing plates, metal sleepers. Without completing the list, mention must be made of the large selection of bars of various sections.

For most components the catalogue gives the quality of steel used, its composition, its mechanical characteristics and often a description of the manufacturing processes. The description given of the finishing process most generally used serves as a guide to prospective buyers.

These will also appreciate the description of the Bessemer installation and its working with all the characteristics of the steels produced by the acid method in the converter.

We must also stress the interest of the lengthy extracts from the « British Standard Specifications » relating to various steel components produced by the United Steel Companies. A very useful supplement to these specifications is the list of tolerances allowed in practice in England which are also given.

Together with the purely numerical and conversion tables given in the appendices is included information intended to facilitate the work of investigation departments.

E. M.

MONTHLY BIBLIOGRAPHY OF RAILWAYS(1)

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(OCTOBER 1954)

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Paris (6^{e}), Plon, Editeur, 8, rue Garancière. Un olume (14 × 23 cm) de 228 pages, avec gravures et lanche hors texte et de nombreux graphiques, croquis t schémas dans le texte. (Prix : broché, 690 fr. fr.)

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Exécution du béton précontraint.
Paris, Eyrolles, éditeur. Un volume (16 × 25 cm) e 116 pages, avec 38 figures et 40 planches hors texte. Prix : 1 350 fr. fr.).

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Paris, Dunod, éditeur. Un volume (16 × 25 cm) de 94 pages, avec 357 figures et 7 planches hors texte. rix : relié toile, 3 500 fr. fr.)

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FFICE D'EXPLOITATION DES TRANSPORTS COLONIAUX (OTRACO).
Rapport 1953.
Bruxelles, OTRACO, 101, avenue Louise. Une rochure (22 × 29 cm) de 54 pages, avec tableaux, graphiues et photos hors texte.

1954 **691**
ERNOT (P.).
Le béton armé.
Paris, Baillière et fils,éditeurs. Un volume (16×25 cm) 450 pages, avec 322 figures et 8 planches hors texte. rix : 3 500 fr. fr.)

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Paris, Office Technique pour l'Utilisation de l'Acier (OTUA), 25, rue du Général Foy. Une brochure (21 × 27 cm) de 24 pages, illustrée.

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AHRONS (E. L.).
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PLESSOW (G.). — **Technische Unfallverhütung** in **gefährlichen Werkstätten** bei der Deutschen Bundes- nn. (5 000 Wörter & Tafeln.)

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PECH (W.) & LAZIK (P.). — Neuartige **Gleisbau- und Gleisunterhaltungsmaschine.** (4 000 Wörter & Abb.)

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WENZEL (W.). — Die Kupfer-Stahl-Verbindung bei **Lokomotiv — Feuerbüchsen.** (Lötschweissverfahren.) (5 000 Wörter & Abb.)

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STEIGER (M.). — Kugelstellwerk für **Ablaufanlagen.** (2 500 Wörter & Abb.)

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Auf dem Wege zur **Standard-E-Lok.** (500 Wörter & Abb.)

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BRILL (A.). — Rückblick und Ausblick für den **maschinentechnischen Dienst** der Deutschen Bundesbahn. (5 000 Wörter & Abb.)

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SCHRÖDER (H.). — Eine **lochlose Schienenstossverbindung.** (400 Wörter & Abb.)

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SCHMIDT (E.). — **Aufbereitung karbonatharte** **Wassers für Lokomotivspeisezwecke** in Teilstrom- Ent salzungsanlagen. (1 700 Wörter & Abb.)

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Von KIRCHBACH (E.). — Amerikanische Stimme zur Wettbewerbsfähigkeit und Weiterentwicklung de **Dampflokomotive.** (3 000 Wörter & Abb.)

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WALK (A.). — Theoretische Betrachtungen übe den **Zusammenstoss zweier Eisenbahnwagen.** (4 00 Wörter & Abb.)

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SCHÄFER (H.D.). — Eine neue Regeltechnik fü die **Zugbeleuchtung.** (2 000 Wörter & Abb.)

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CABRIAN (M.). — Der **Einfluss der Geschwindigkei ausgelasteter Durchgangsgüterzüge auf die Betriebs wirtschaftlichkeit.** (4 000 Wörter & Abb.)

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HÜRLIMANN (W.). — Der **Zubringerverkehr** (4 000 Wörter & Abb.)

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Dr.-Ing. FROHNE. — Die **gemeinsamen Problem der europäischen Eisenbahnen** und ihre Stellung zu **Verkehrsintegration.** (6 000 Wörter.)

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HEIMES (A.). — Die **Einordnung des Strassenver kehrs in die gemeinwirtschaftliche Verkehrsbedienung** (5 000 Wörter.)

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HARRAND (G.). — **L'activité ferroviaire en 1952.** 5 000 mots.)

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Die gemeinwirtschaftlichen und betriebsfremden Lasten er Deutschen Bundesbahn. (2 000 Wörter.)

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GROSSKURTH (K.). — **Die Verwendung von Propan der Signaltechnik.** (4 950 Wörter & Abb.)

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RÜFFLER (D.). — Die **Richtfunkanlage** Essen im ındesbahn- Richtfunknetz. (2 500 Wörter & Abb.)

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MEYER (H.R.). — Das Prinzip der **Eigenwirtschaft-hkeit des Schienen- und Strassenverkehrs.** Voraussetzgen und wirtschaftliche Konsequenzen. (1 500 rter.)

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OHL (A.). — Die **Binnenschiffahrt in den USA im ttbewerb mit den Eisenbahnen.** Eindrücke einer t hand- Studie in Amerika und Vergleiche mit den rhältnissen in Europa. (2 000 Wörter & Karte.)

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NOCK (O.S.). — **Improving modern locomotive performance** (7 500 words & figs.)

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LIVESAY (E.H.). — **French locomotive experiences** *(to be continued)*. (32 000 words & figs.)

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Southern Region change of frequency scheme. (3 400 words & figs.)

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Electric rolling stock for Toronto subway (2 000 words & figs.).

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Diesel-electric locomotives for Australia (1 700 words & figs.)

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WILSON (G.R.S.). — **Safety on the Railways** (1 600 words.)

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Electric locomotives for Manchester-Sheffield line. (600 words & fig.)

1954 **625** .15 (42) & **656** .284 (42)
Engineering, March 19, p. 358.
Collapse of the Clifton Hall tunnel. (300 words.)

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Measurement of train resistance. (1 600 words.)

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Derailment of an express train. — « Hunting » of engine. (600 words)

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Coal-burning gas turbine for locomotives *(to be continued)* (4 200 words & fig.)..

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HAUT (F.J.G.). — **Locomotives for 50 cycle traction S.N.C.F.** (400 words & figs.)

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New Dutch locomotives. (350 words & fig.)

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International Railway Congress. (600 words.)

1954 **621** .338 (494)
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Electric baggage cars for L.M.R. (400 words).

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uthern Suburban electrification. (2 000 words & figs.)

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954 **621** .335 (44)
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954 **621** .335 (945)
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Railway Age, March 1, p. 22.
High-capacity all-service Diesel. (1 400 words & figs.)

1954 **625** .232 (73)
Railway Age, March 1, p. 25.
In this new car... 169 seats for commuters. (500 words & fig.)

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More aluminium alloy passenger cars for the up. (2 000 words & figs.)

1954 **621** .335 (73)
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Rectifier interference cut on telephone lines. (600 words & figs.)

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AMES (E.W.), HUTCHISON (W.M.) and MOORE (V.A.Jr.). — **New Haven installs ignitron M.-U cars.** (1 400 words & figs.)

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13 car types meet traffic needs. (2 800 words & figs.)

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Coach passengers get a break. (2 400 words & figs.)

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Grade crossing deaths cut 97.4 %. (800 words, table & figs.)

The Railway Gazette. (London.)

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GRANT (J.C.). — **Overhead contact systems.** (1 000 words and figs.)

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The Railway Gazette, October 9, p. 403.
Lancaster- Morecambe-Heysham Electrification. (2 800 words and figs.)

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Remote-drive speed measuring instruments. (1 700 words and figs.)

1953 **625** .242 (56)
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Experimental bogie high side wagon. (700 words & fig.)

1953 **625** .17 (73)
Railway Gazette, October 23, p. 465.
Protecting railway sleepers in U.S.A. (700 words & fig.)

1953 **625** .245 (71)
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Canadian National Railways road-rail service. (500 words & fig.)

1953 **625** .17 (42)
Railway Gazette, November 23, p. 573.
Fastening flat-bottom track. (1 800 words & figs.)

1953 **625** .212 (42)
Railway Gazette, November 23, p. 577.
Centreless grinding of rolling stock axles. (1 200 words & fig.)

1953 **621** .331 (42)
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New traction substation at Surrey Docks, L.T.E. (1 400 words & figs.)

1953 **656** .211.7 (43)
Railway Gazette, November 27, p. 605.
The Grossenbrode-Gedser ferry service. (1 200 words & figs.)

1953 **621** .33 (44)
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Swiss-built Bo-Bo locomotives in France. (650 words & figs.)

1954 **625** .42 (71)
The Railway Gazette, January 8, p. 39.
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1954 **625** .232 (460)
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Talgo trains in Spain. (1 300 words)

1954 **621** .431.72 (42)
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Diesel-mechanical shunting engines. (350 words.)

1954 **656** .28 (42)
The Railway Gazette, January 22, p. 88.
Colonel Wilson's annual report. (4 000 words & tables.)

1954 **625** .17
The Railway Gazette, January 22, p. 95.
Organisation of track maintenance. (1 400 words.)

1954 **621** .335 (945)
The Railway Gazette, January 22, p. 96.
Electric locomotives for Victorian Railways. (3 500 words & figs.)

1954 **725** .3
The Railway Gazette, January 29, p. 123.
Modern constructional problems. (1 100 words.)

1954 **621** .132.5 (42)
The Railway Gazette, January 29, p. 124.
British Railways heavy freight locomotives. (2 850 words & figs.)

1954 **625** .17
The Railway Gazette, February 5, p. 150.
Track maintenance problems. (1 850 words.)

1954 **625** .13 (42)
The Railway Gazette, February 5, p. 154.
New method of bridge reconstruction in the London Midland Region. (900 words & figs.)

1954 **625** .231 (54)
The Railway Gazette, February 5, p. 157.
Swiss-built carriages for India. (800 words.)

1954 **621** .131.2
The Railway Gazette, February 12, p. 178.
Methods to increase the efficiency of steam locomotives. (3 000 words.)

1954 **625** .232 (494)
The Railway Gazette, February 12, p. 181.
High-capacity for Swiss Federal Railways. (500 words & figs.)

1954 **621** .132.1 (46)
The Railway Gazette, February 12, p. 183.
North-British Mikado-type locomotives for Spain. (1 900 words & figs.)

Diesel Railway Traction. (London.)

1953 **621** .431.72 (43)
Diesel Railway Traction, November, p. 241.
German 2 000 HP Diesel-hydraulic locomotives (4 500 words & figs.)

1953 **621** .431.72
Diesel Railway Traction, December, p. 263.
Diesel Traction in 1953. (18 000 words & figs.)

1954 **621** .431.72 (469
Diesel Railway Traction, January, p. 5.
Triple-car trains in Portugal. (800 words & figs.

1954 **621** .431.72 (492
Diesel Railway Traction, January, p. 13.
Main-line locomotives in Holland. (600 words & figs.

1954 **621** .431.72 (48
Diesel Railway Traction, January, p. 15.
Diesel locomotives for Finland (1 100 words & figs.)

1954 **621** .431.72 (6
Diesel Railway Traction, January, p. 18.
Locomotives for steep grade working. (1 600 word & figs.)

1954 **621** .431.72 (496
Diesel Railway Traction, January, p. 21.
Shunting locomotives for Turkey. (400 words & figs.

Railway Steel Topics. (Sheffield.)

1954 **625** .143.
Railway Steel Topics, Summer, p. 32.
TURNER (J.H.). — **Roaring rails. The corrugatio** of steel rails. (7 800 words.)

1954 **621** .131.
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GELSON (W.E.). — **Vehicle mechanics of locomotive** (6 800 words & figs.)

In Danish (= 439.81).

Ingeniøren. (Copenhagen).

1953 **625** .114 (48[illegible]) = **436** .81

ngeniøren, No. 42, 17/10, p. 760

BROEN CHRISTENSEN (Ch.). — **Falling in of** e **embankment** on the Silkeborg-Kjellerup line, on e 30th May 1953. (2 400 words & figs.)

1953 **625** .13 (492) = 439 .81

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EGGNIK (A.). — The **tunnel** near Velsen, in the etherlands. (1 400 words & figs.)

1954 **624** .21 : **656** (485 + 489) = 439 .81

geniøren, No. 4, 23/1, p. 91.

Christiani & Nelsen, Kampmann & Saxild, Højgaard Schultz, Byggnadsaktiebolaget Contractor, A/B Armerad etong, A/B Skånska Cementgjuteriet. — **Denmark-weden Autostrada** linking Copenhagen and Malmö cheme submitted to the Danish and Swedish Govern-ents by the above-mentioned Danish and Swedish gineering firms.) (5 300 words & figs.)

Sikringsteknikeren. (Copenhagen.)

1953 **656** .257 (489) = 439.81

kringsteknikeren, No. 2 and 3 p. 545.

WESSEL HANSEN. — **Relay installation** type SB 1953. (3 900 words & fig.)

In Spanish.

Boletin de la Asociación permanente el Congreso Panamericano de Ferrocarriles. (Buenos-Aires.)

1954 **625** .232 (460)

letin de la Asociación permanente del Congreso Panamericano de Ferrocarriles, marzo-abril, p. 42.

El **Tren Talgo.** La nueva tecnica de rueda libre y rigida en la República Argentina. (6 000 palabras & fig.)

Ferrocarriles y Tranvias. (Madrid.)

1954 **625** .617

rrocarriles y Tranvias, abril, p. 124.

SALDAÑA MUZQUIZ (L.). — **Los vagones de ejes ercambiables.** Su aparición y desarrollo progresivo. 000 palabras & fig.)

1954 **625** .28 (460)

rrocarriles y Tranvias, mayo, p. 164.

ESCARIO (F.). — **Resultados obtenidos con los nes antomotores** de la RENFE. (2 000 palabras & fig.)

1954 **385** .517.6 (460)

Ferrocarriles y Tranvias, mayo p. 172.

BRAVO SANFELIU (J.). — El **servicio asistencial de medicina preventiva** de la RENFE. (1 000 palabras.)

Revista de Obras Publicas. (Madrid.)

1954 **625** .251

Revista de Obras Públicas, junio, p. 286.

De GOYENA (J.M.P.). — **Frenado decelerometrico.** (5 000 palabras & fig.)

In Italian.

Giornale del Genio Civile. (Roma.)

1954 **691**

Giornale del Genio Civile, aprile, p. 259.

LEVI (F.). — Il problema degli **acciai per cemento armato precompresso.** (1 800 parole, tavole & fig.)

La Ricerca Scientifica. (Roma.)

1954 **625** .251

La Ricerca Scientifica, giugno, p. 1219.

LEUZZI (V.). — **Sollecitazione eccezionale degli alberi di motori tramviari o ferroviari durante la frenatura.** (2 500 parole & fig.)

Ingegneria Ferroviaria. (Roma.)

1954 **625** .14

Ingegneria Ferroviaria, febbraio, p. 101.

LO CIGNO (E.). — Il **calcolo approssimato dell' armamento ferroviario.** (3 000 parole, tabelle & fig.)

1954 **385** .1 & **656** .2

Ingegneria Ferroviaria, febbraio, p. 111.

SAVOJA (A.). — Le variazioni dei **costi dei trasporti ferroviari.** (2 000 parole & tabelle.)

1954 **625** .144.3

Ingegneria Ferroviaria, febbraio, p. 117.

MARINELLI (G.). — Della inserzione dei **raccordi di transizione** a curvatura variabile agli estremi delle curve ferroviarie. (4 000 parole & fig.)

1954 **625** .234

Ingegneria Ferroviaria, febbraio, p. 125.

PAFI (E.). — Studio sul **condizionamento dell' aria** negli elettrotreni. (4 500 parole, tabelle & fig.)

1954 **621** .438

Ingegneria Ferroviaria, marzo, p. 177.

MÜLLER (A.E.) & CORBELLINI (F.). — Evoluzione e applicazione della turbina a combustione in particolare nel campo della trazione ferroviaria. (8 000 parole & fig.)

1954 **621** .89

Ingegneria Ferroviaria, marzo, p. 208.

MECOCCI (G.) & ABRAMO (F.). — Ricerche di laboratorio su alcuni grassi e relative miscele per la **lubrificazione** dei cuscinetti a rotolamento. (2 000 parole & fig.)

1953/54 **725** .31

Ingegneria Ferroviaria, ottobre, p. 693, novembre, p. 803, febbraio, p. 135; marzo, p. 215; giugno, p. 511.

LENA (V.). — Le **grandi stazioni per viaggiatori.** (17 000 parole & fig.)

Rivista di Ingegneria. (Milano.)

1954 **62** (01 & **691**

Rivista di Ingegneria, febbraio, p. 141.

RINALDI (G.). — **Introspezione radiografica dei calcestruzzi per l'esame di strutture in cemento armato normale e precompresso.** (4 000 parole & fig.)

1954 **624** .2

Rivista di Ingegneria, marzo, p. 289.

FANELLI (E.). — **Linee d'influenza nelle travi continue.** (3 000 parole, tavole & fig.)

1954 **625** .13 (44 + 45)

Rivista di Ingegneria, marzo, p. 323.

GARRONI (R.). — Studio per la costruzione e l'esercizio della costruenda **galleria del Monte Bianco ventilabile secondo un nuovo sistema brevettato.** (1 000 parole & fig.)

1954 **624** (45) & **691** (45)

Rivista di Ingegneria, maggio, p. 525.

VICHI (G.). — **Ponte precompresso** sul fiume Arno a Caprona (Pisa). (2 000 parole & fig.)

In Netherlands.

De Ingenieur. ('s-Gravenhage.)

1954 **625**. 1 (492)

De Ingenieur, n^r 2, 8 Januari, p. V. 1.

Wijziging van spoorwegen en stations in en om Rotterdam. I. Spoorwegwerken Rotterdam van **exploitatiezijde** bezien, door W.J. DE GRAAFF. II. Spoorwegwerken Rotterdam van **bouwtechnische zijde** bezien, door Ir. S. NOYON. (5 000 woorden & fig.)

1954 **621** .33 (492) & **656** .256 (492)

De Ingenieur, n^r 3, 15 Januari, p. E. 1. n^r 7, 12 Februari, p. E. 7.

De **electrificatie** der Nederlandse Spoorwegen. I. Algemene inleiding, uitrusting onderstations en bovenleiding door E. VAN DER HOEK. — II. Automatisch blokstelsel en beveiliging, door J.J. DE HEER. (4 000 woorden & fig.)

1954 **621** .33 (44

De Ingenieur, n^r 17, 23 April, p. E. 39.

FONTEIN (W.). — **Electrische tractie met behul van wisselstroom met een frequentie van 50 H** bij d Fransche Spoorwegen. (6 000 woorden & fig.)

Spoor- en Tramwegen. (Utrecht.)

1953 **385** (07.4 (492

Spoor- en Tramwegen, n^r 26, 24 December, p. 481

ASSELBERGHS (H.). — **Spoorwegmuseum** in eiger huis en terug in Utrecht. (2 000 woorden & fig.)

1953 **725** .31 (492

Spoor- en Tramwegen, n^r 26, 24 December, p. 490

ENTKEN (J.F.A.M.). — **Verbouwing van de ha** van Amsterdam C.S. (1 000 woorden & fig.)

1954 **385** (061.

Spoor- en Tramwegen, n^r 1, 7 Januari, p. 1.

ROBBÉ GROSKAMP (H.A.). — Opzet en werk zaamheden van het **Bureau voor Research en Proef nemingen (Office de Recherches et d'Essais : O.R.E.)** van de Internationale Spoorweg-Unie (U.I.C.). Voor woord door Ir. F. Q. DEN HOLLANDER. (4 00 woorden.)

1954 **385** (09 (492

Spoor- en Tramwegen, n^r 1, 7 Januari, p. 6.

De **Nederlandsche Spoorwegen** in 1953. (1 500 woorden & fig.)

1954 **656** (492

Spoor- en Tramwegen, n^r 4, 18 Februari, p. 53; n^r 5 4 Maart, p. 74.

TISSOT VAN PATOT (J.P.B.). — De **deelnemin van N. S. aan het goederenvervoer op weg, resp. te water** (5 000 woorden.)

1954 **656** .21 (492

Spoor- en Tramwegen, n^r 4, 18 Februari, p. 57.

ENTKEN (J.F.A.M.). — **Nieuwe stations** voo Rotterdam. (1 200 woorden & fig.)

In Norwegian (= 439.82).

Teknisk Ukeblad. (Oslo.)

1953 **625** .42 (485) = 439.8

Teknisk Ukeblad, n° 46, 10/12, p. 985.

TENGBLAD (E.). — Experience gained during th building and working of the **Stockholm undergroun railway.** (4 500 words & figs.)

In Swedish (= 439.71).

Järnvägs-Teknik. (Statsbaneingenjören). (Stockholm.)

1953 **625** .144.4 (485) = 439.71
Järnvägs Teknik, nº 7, p. 223.
A new member in the VIBRO's family. (600 words & fig.)

1953 **625** .143.2 (485) = 439.71
Järnvägs-Teknik, nº 7, p. 234.
Rail manufacture at the Domnarfvet Engineering Works. (500 words & fig.)

1953 **625** .143.5 (44) = 439.71
Järnvägs Teknik, nº 9, p. 304.
JULIEN (P.). — The **fastening of rails** with double elastic spikes, ribbed rubber soleplates and « R.N. » elastic clips. Rails of great length. (1 800 words & fig.)

1953 **625** .143.5 : **625** .14 = 439.71
Järnvägs-Teknik, nº 9, p. 308.
LUNDEN (N.). — **Use of rubber on the permanent way.** (1 800 words & fig.)

1953 **625** .143.5 : **625** .14 (485) = 439.71
Järnvägs-Teknik, nº 9, p. 314.
SCHRÄDER (SVEN E.). — **Interposition of rubber on the permanent way.** (1 400 words & figs.)

Nordisk Järnbane Tidskrift. (Stockholm.)

1953 **656** .254 (489) = 439.81
Nordisk Järnbane Tidskrift, nº 10, p. 253.
KRISTIANSEN (E.). — **Radio-telephony on the DSB** (3 300 words & fig.)
TOIVOLA (K.). — Finnish report. (1 100 words.)
SAXE GAARD (L.). — Norwegian report. (1 200 words.)
ABRAHAMSON (B.). — Swedish report. (1 300 words.)

1953 **625** .233 (481) = 439.81
Nordisk Järnbane Tidskrift, nº 10, p. 274.
SOLBERG (E.). — **Lighting of the rolling stock.**
HAMMERSHÖY (K.A.). — Danish report. (1 200 words & fig.)
LARKKO (O.). — Finnish report. (1 100 words & fig.)
RIDAL (F.). — Swedish report. (1 900 words.)

1953 **625** .151 : **625** .174 (489) = 439.71
Nordisk Järnbane Tidskrift, nº 11, p. 302.
GÖTSCHE (O.). — **Electrical switch heaters for melting the snow.** (1 100 words, illustrated.)

Spårväg och Buss. (Stockholm).

1953 **656** .254.15 (485) = 439.71
Spårväg och Buss, nº 9, 15/11, p. 133.
BOBERG (I.). — **Loudspeaker installations** on T line and on the outside system. (2 000 words & fig.)

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